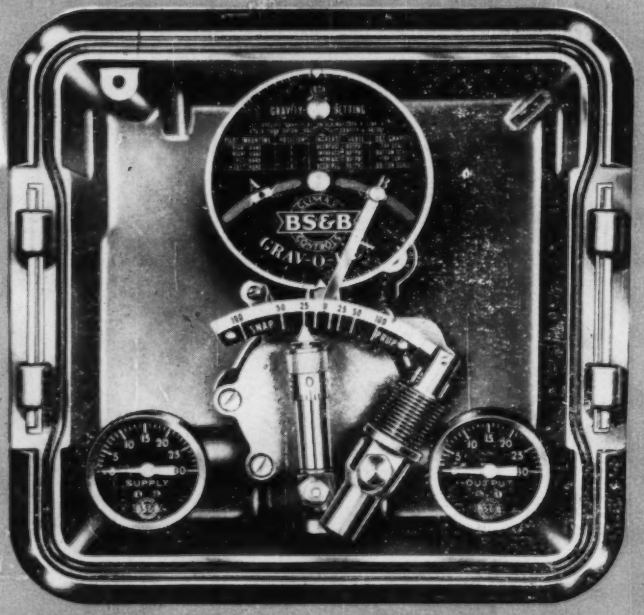
INSTRUMENTS and AUTOMATION

Volume 28, Number 1

January, 1955

Here's The New Liquid Level Control Pilot Everybody's Talking About!

It's The New BS&B CLIMAX Type 1450!

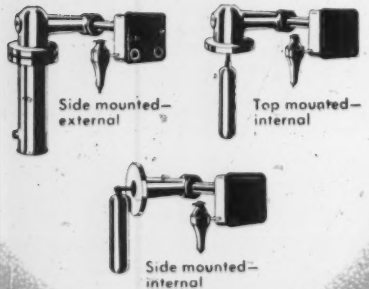


After more than two years of development and thorough field testing under all conditions, the new BS&B CLIMAX Type 1450 Liquid Level Control Pilot is now available, and is already the most talked about instrument of its kind in the industry today!

Type 1450 is the *only* liquid level controller on the market which is so versatile that it can be used for liquid level transmission service, proportional throttling service *and* for "on-off" snap action! This makes it easy for you to transfer it quickly from one service to another, as your needs may require.

You will be surprised and pleased with its performance and simplicity. Call or write your BS&B Representative. He will be glad to give you the complete story on this all-new liquid level control pilot.

Type 1450 Mounts To Torsion Tube Controller In 3 Ways:



CONSTRUCTION FEATURES

- V Weatherproof Case Of Die Cast Aluminum Designed For Universal Mounting.
- V Compact Size — 8" x 8" x 4".
- V Two-Way Door Opens From Either Left Or Right, As Convenient.
- V Straight Line Piping.
- V Push Button Feed Orifice Cleaner.
- V Pilot Action Reversible By Moving A Single Link, Without Tools.
- V Snap Action Or Proportional Band Settings Can Be Made Without Tools.
- V No Loose Linkages, Resulting In Easier Adjustment And Greater Sensitivity.
- V Easy Parts Replacement Or Assembly.

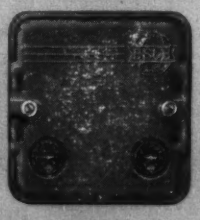
OPERATIONAL FEATURES

Straight Line Proportional Action!

- V Factory Calibration Of Proportional Bellows, Feed Orifice Nozzle and Proportional Snap Action Band Scale.
- V Spring Loaded Bellows With Built-In Overtravel Protection.
- V Flow Tested Feed Orifice Nozzle With Graduated Micrometer Set Point Adjustment.
- V Reflects Changes In Liquid Level, Changes In Gravity.
- V Can Be Used For Liquid Level Transmission Service, Proportional Throttling Service Or "On-Off" Snap Action.

Improved Sensitivity and Faster Controller Response Through The Power Relay Mechanism

- V Double Diaphragm, Pressure Balanced.
- V Molded Diaphragms.
- V High Capacity Pilot Valve.
- V Intermittent Bleed.



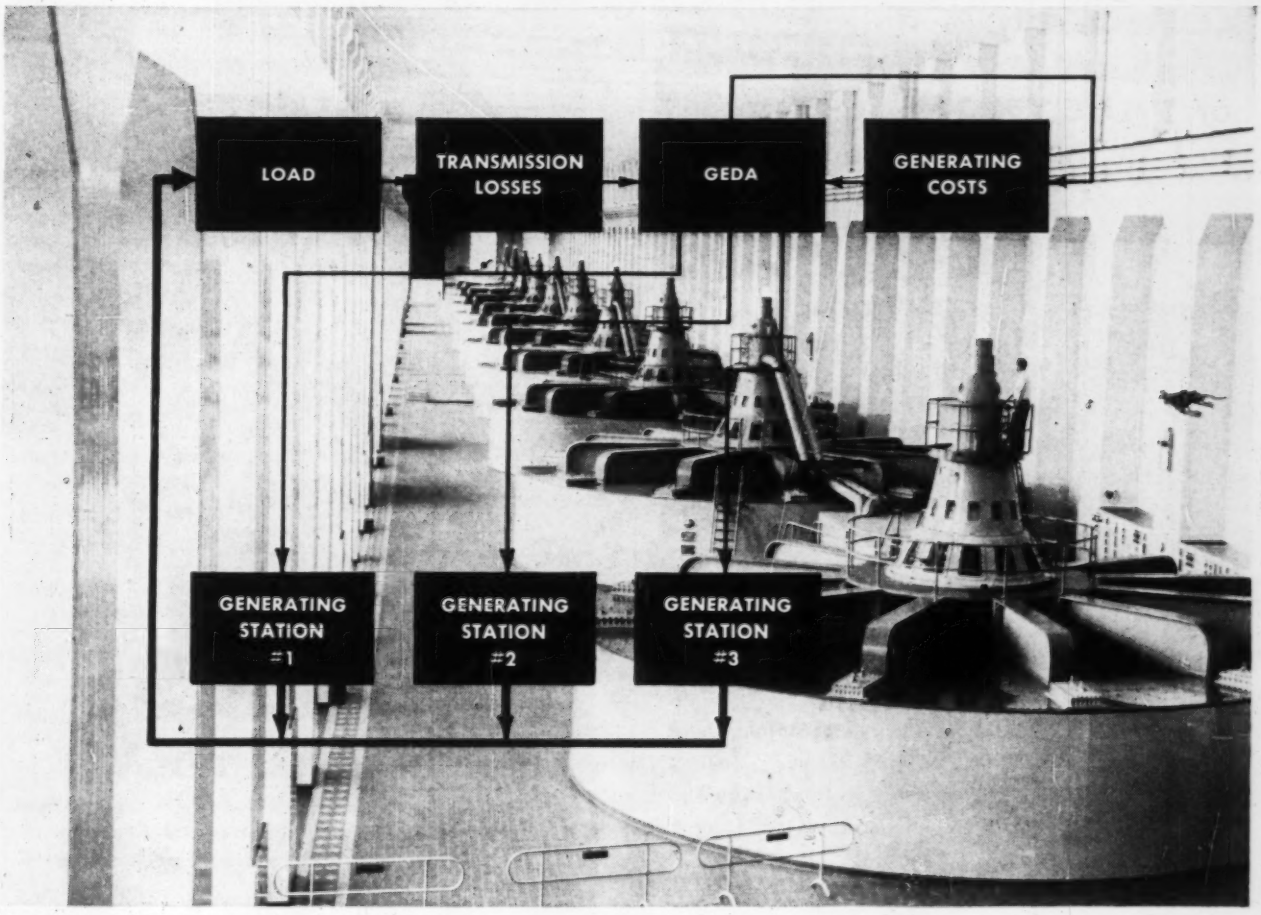
For Better Process Controls . . . Always Specify BS&B Climax!

BLACK, SIVALLS & BRYSON, INC.
Climax Controls Division, Dept. 4-VI
7500 East 12th Street • Kansas City 26, Missouri

EFFICIENCY
OVER 60 YEARS
BS&B
RELIABILITY

For more information circle 1 on inquiry card.

GEDA SOLVES CONTROL PROBLEMS



This problem is typical of one you would run up against in the electric power industry. *But if your business is not electric power*—then change the control problem illustrated aboye to one facing you in your plant right now, inject your own variables!

For our point is this:

GEDA can expedite the analysis and solution of difficult control problems facing ANY industrial operation.

The particular application makes no difference to this versatile analog computing equipment of advance design, engineered and built by Goodyear Aircraft Corporation.

Its advantages are many, as a host of development engineers already have been quick to discover.

For sheer ease of operation it is unexcelled, GEDA delivers results in wave forms and voltages—easily translated by the engineer, no specialized mathematics needed!

Noted for its accuracy, the GEDA stabilized electronic multiplier is the acknowledged leader in its field—all GEDA plug-in units are automatically and continuously stabilized.

Why not investigate *the amazing scope, capacity and benefits offered by the computing line of advanced design—GEDA, built only by Goodyear Aircraft? FREE CATALOG ON REQUEST—Address: Goodyear Aircraft Corporation, Dept. 931EA, Akron 15, Ohio.*

GEDA—*best way to give a hunch a chance*

GOODYEAR AIRCRAFT

GEDA—T. M. Goodyear Aircraft Corporation, Akron 15, Ohio

For more information circle **2** on inquiry card.

if it's **METAL FABRICATION**

your **FALSTROM** man has the answer!

cabinets
panel boards
small parts
enclosures
cubicles
housings
chassis
consoles

- fabrication of large or small shapes to close tolerances.
- fabrication in aluminum, sheet steel, stainless steel, copper, brass and other alloys.
- complete design-engineering-production service.
- stock tools, dies, jigs . . . standard fabricating techniques employed wherever possible.
- modern facilities for punching, shearing, bending, welding, finishing.

Write for literature, bulletin 143A on Falstrom enclosures, or send prints for analysis by trained engineers, without obligation.

Falstrom means it's that much better!

FALSTROM

FALSTROM COMPANY, 93 Falstrom Court, Passaic, N. J.
PRescott 7-0013 **Since 1870**

For more information circle **3** on inquiry card.

"DEMI"®

ANOTHER PACKLESS MINIATURE VALVE

If your valve requirements specify packless design for on-off service, vacuum to 1500 psi, with space allowance no more than 3" diameter by 4½" high — our "DEMI" design is the answer.

Bodies are available in all materials. The connections can be butt weld, as shown, or threaded, flanged or integral tubing. The reverse acting diaphragm operator can be rotated in any position to facilitate installation of control air. Direct acting operators are also standard with 2½ to 15 square inch effective area for 3 to 15 psi control pressure. Special operators for pressure up to 2000 psi are also available.

For prices, in various materials and porting arrangements, inquire of our local representative in your area, or directly to our home office.

OTHER PRODUCTS MANUFACTURED

VALVES, ⅛" to 2" — diaphragm or piston operator — packed or packless — two or three-way — straight through, angle or offset for full drainability.

MANIFOLDS, 2-3-4 or 5 valve, in sizes ⅛" to ½".

MACHINED TEFLON, Seals, gaskets, bearings and other special shapes to your specifications.

SPECIAL PRODUCTS, Engineered to meet your requirements.

George W. DAHL Company
BRISTOL, RHODE ISLAND

For more information circle **4** on inquiry card.

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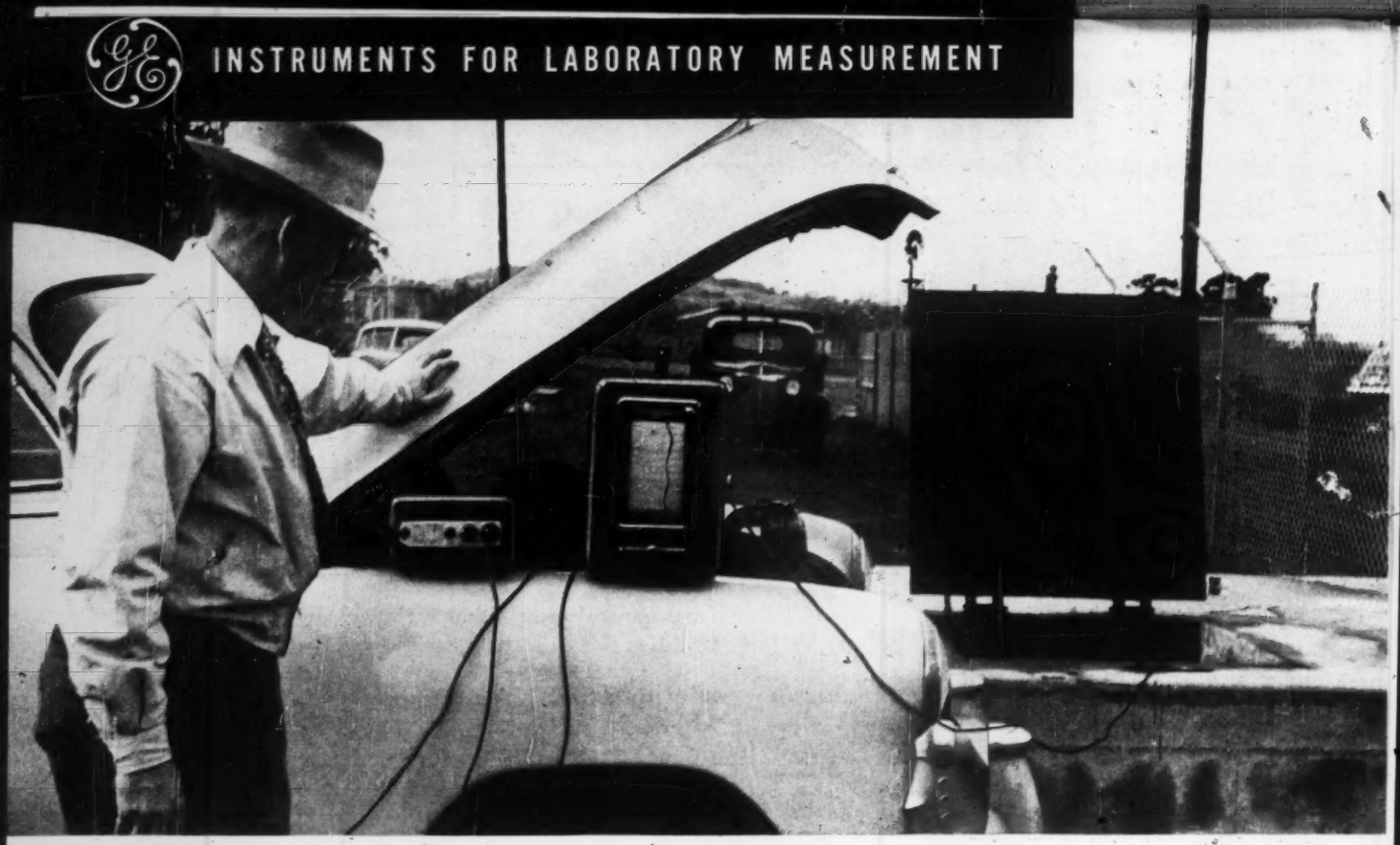
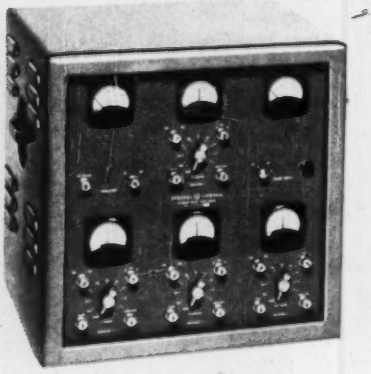
INSTRUMENTS FOR LABORATORY MEASUREMENT



LABORATORY FIELD TESTS are successfully conducted by the East Bay Municipal Utility District, Oakland, California, by using G.E.'s photoelectric recorder to locate pipe-line corrosion. Fred Terry, District Corrosion engineer, found that this recorder provided the most satisfactory method of determining where corrosion danger exists. The recorder was used to make electrolysis surveys of a 94-mile stretch of pipe. A car battery and 60-cycle vibrator furnished the power. The recorder does not need constant balancing.

News About Other General Electric Instruments for Precision Measurement in the Laboratory

STRAIN GAGE AMPLIFIER



STABILIZED for line-voltage, or tube-characteristic variations, the strain gage amplifier operates on d.c. or 0 to 1500 cps a.c. Two-channel, $1900.00; four-channel, $3200.00*.

SELF BALANCING POTENTIOMETER

HIGHLY STABLE MEASURABLE CURRENTS are furnished from small d-c voltages. Input: 100 uv to 1 v, d.c. Output: 5 ma d.c. for all output circuits up to 1500 ohm. $258.19*.

Manufacturer's suggested retail price.

For more information circle 5 on inquiry card

FROM LABORATORY ANALYSIS TO FIELD TESTING . . .

G.E.'s Portable Photoelectric Recorder Assures Precise, Convenient Measurement

Designed for recording rapidly changing phenomena, General Electric's photoelectric recorder features unlimited versatility combined with the convenience of portability. With sensitivity and response characteristics of the most sensitive indicating instrument, the portable photoelectric recorder can provide direct ink records of the transient phenomena being investigated.

HIGH-SPEED RESPONSE, as high as 1/5 second for full-scale deflection, is another outstanding feature of G.E.'s recorder. Chart speeds range from ½ inch per hour to 72 inches per minute, and sensitivities are as great as 1.0 microamperes full-scale. Single-, double-, and triple-speed chart carriages are available.

HIGHLY VERSATILE, G.E.'s photoelectric recorder is ideal for any permanent or temporary test where only a small amount of energy is available to deflect the recorder pen. The amount of energy required to operate the portable recorder can be in the order of one millionth of the energy required to operate a direct-acting recorder.

DESIGNED FOR PORTABLE USE, the photoelectric recorder is supplied with a convenient carrying strap and weighs but 35 pounds. The recorder can be used to record electrical quantities, such as volts, amperes, and frequency, and non-electrical quantities, such as speed, sound, pressure, strain, light, and vibration. Price is $698.88*.

INFRARED METER

SIMPLE AND CONVENIENT measurement of radiant energy intensity of 0 to 10 watts per sq. in. is provided. Response range is 0.3 to 3.5 microns. Price, $48.75* or $67.47*.

MOLECULAR VACUUM GAGE

NO PRIMARY ELEMENT TO BURN OUT, this new gage is provided with a dry-air scale of 0 to 20 mm; or for other gases, 0 to 100 uniform scale divisions. Price, $195.00*.

SECTION D 605-75
GENERAL ELECTRIC COMPANY
SCHENECTADY 5, N. Y.

Please send me the following bulletins:

- ☐ Strain Gage Amplifier (GEC-1248)
- ☐ Self-Balancing Potentiometer (GEC-367)
- ☐ Radiation Meter (GEC-381)
- ☐ Molecular Vacuum Gage (GEC-986)
- ☐ Photoelectric Recorder (GEC-254)

Name .....

Company .....

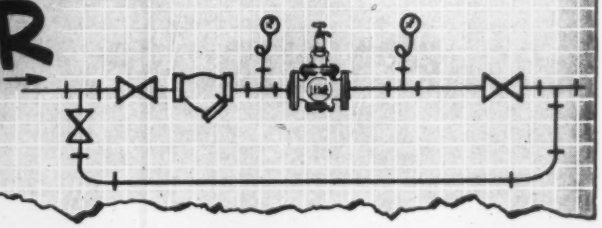
Street .....

City ..... Zone ..... State .....

GENERAL ELECTRIC

For more information, circle 5 on inquiry card.

WHEN TO USE A REGULATOR



SELF-CONTAINED PRESSURE, TEMPERATURE AND PUMP PRESSURE REGULATORS

Leslie Self-Contained Regulators are spring loaded, internal pilot, piston or diaphragm operated with stellited seating surfaces, hardened stainless steel main valves and renewable wearing parts of heat treated stainless steel of grades best suited to the application.

Regulators are used for any one or any combination of the following conditions:

★ When quick response is necessary to handle sudden load changes.

★ When available fluid pressure supplies sufficient differential for self operation.

★ When positive dead end shutoff is required for short periods of time.

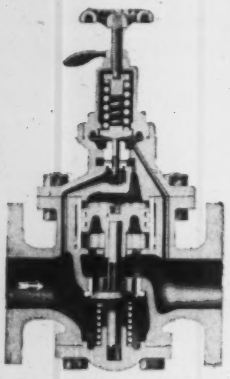
★ When one-step pressure reductions are desired.

★ When service conditions require continuous flow for varying demand.

★ When "instrument control" is required without auxiliary operating force.

★ When installation requires smallest physical dimensions.

★ When operation from either a nearby or a remote control station is desired.

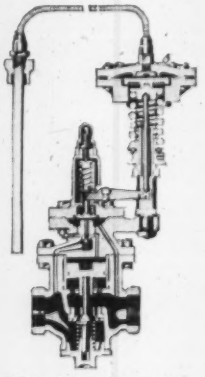


Pressure Reducing Valve
Class L-3

LESLIE
PRESSURE REDUCING VALVES

Automatically maintain a constant reduced pressure of steam, air or gas. Single seated, tight closing. Respond instantly to load changes. Renewable, interchangeable parts. Stellited seating surfaces. Complete overhaul permitted without removing body from pipe line. Made in bronze, cast iron, cast steel or cast alloy steels. Sizes ½" to 6". Other units available for constant differential pressure, unloading, and for remote adjustment. Inlet pressures 25 psi to 1500 psi steam at 950°F. Reduced pressures 2-600 psi.

SEND FOR BULLETIN 5302



Temperature Regulator
Class LTCO

LESLIE
TEMPERATURE REGULATORS

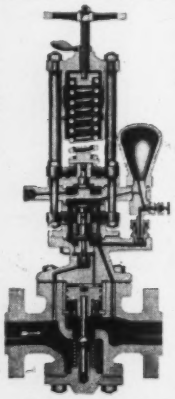
Designed for a wide range of applications. Vary the flow of steam or cooling water to heater or process to automatically maintain constant temperature. Rugged 100° F. adjustable range thermostatic element. For small and large flows, direct operated, direct and reverse acting or with "Duomatic", two-element (pressure and temperature) control. For driers, fuel oil heaters, instantaneous and storage heaters, kettles, open tanks, ovens, process heaters, degreasing machines, steam tables, sterilizers, storage heaters, urns, etc.

SEND FOR BULLETIN 5307

LESLIE
PUMP PRESSURE REGULATORS

Accurately and automatically control discharge pressure from steam operated, reciprocating or turbine driven pumps. Single seated—positive—responsive and accessible. No packed plungers or stuffing boxes. Built for constant discharge pressures of 8 psi to 2000 psi and excess pressure of 10-200 psi. For motor-driven pump discharge pressure recirculation.

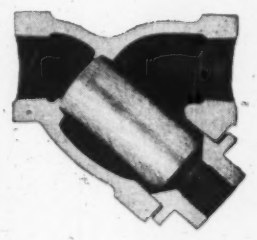
SEND FOR BULLETIN 5306



Pump Governor
Class CTHS-3

LESLIE
SELF-CLEANING STRAINERS

Recommended to protect all regulating equipment from dirt and foreign matter. Cast iron, bronze, cast steel, carbon moly, chromemoly, stainless and forged steels. Strainers with screwed, flanged, socket and butt welded connections; sizes ⅛" to 10" inclusive. Primary service ratings to 2500 psi. Screens furnished in Monel and stainless steel with various perforations and meshes for liquid, gas, air, oil and steam services. For complete details on each type, ask for Bulletin 5308.



Self-Cleaning Strainer

LESLIE REGULATORS

SINCE 1900

TRADE LESLIE MARK

LESLIE CO., 299 GRANT AVENUE · LYNDHURST, N. J.

"STILL FAR AHEAD IN QUALITY AND PERFORMANCE"

For more information circle 6 on inquiry card.

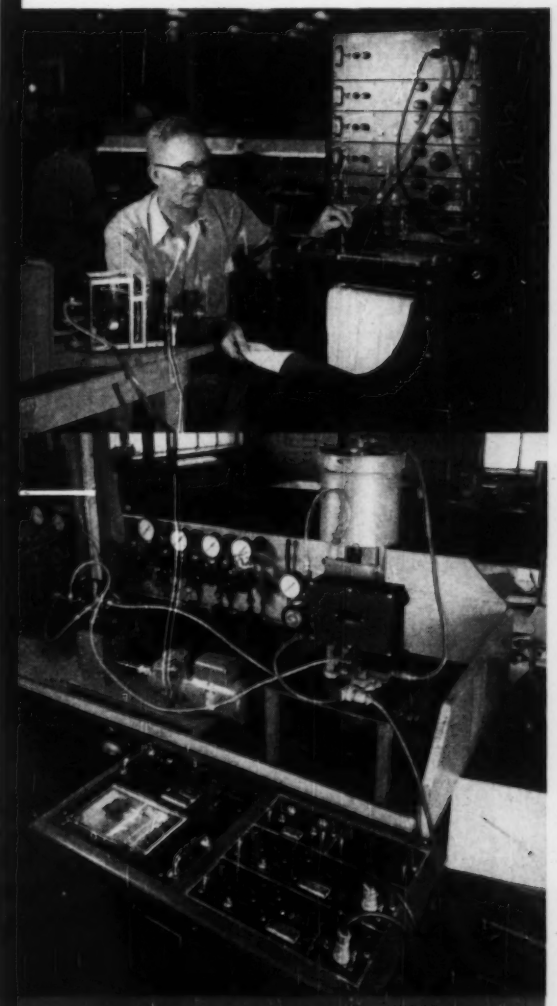
How two TYPICAL production testing headaches were cured with SANBORN OSCILLOGRAPHIC RECORDING SYSTEMS

RAYTHEON MANUFACTURING COMPANY'S Waltham, Mass. Inspection Dept. formerly found their incoming inspection of complex, multi-ganged potentiometers a time-taking and costly job which involved tedious calibration, instrument set-up and testing for *each* of the five potentiometer sections, with each operation subject to inevitable human error.

Today, by using a Sanborn four-channel Recording System and a Potentiometer Power Supply, a visual, concurrent strip-chart record of *five* channels (using marker stylus) of phenomena such as phasing, shorting bar, winding noise, and resolution of winding turns is provided. Inspection time is speeded up 900%, the operator sees immediately all causes for rejection, the chart is a permanent test data record, one inspector takes the place of three, and human error is reduced to a negligible factor.

MOORE PRODUCTS COMPANY of Philadelphia uses a Sanborn Model 60 two-channel Recording System to check the Dynamic Performance of their Valve Positioners, which are used on diaphragm top-work valves and power cylinders. The valve positioner acts as a relay, applying additional air pressure to the cylinder or top-work, overcoming effects of unbalance and friction, and compelling the valve stem to take the position dictated by the pneumatic controller or manually-operated air load. A feed-back linkage assures positioning of the valve stem within plus or minus 0.001".

A pneumatic sine wave generator supplies pneumatic impulses with frequencies as high as 20 cycles per second. These impulses are sent to the valve positioner and to a transducer which converts the signal for the recorder. The response of the valve stem is measured by a strain gage pickup for the second channel of the recorder.



The above cases are but two of the many applications possible with Sanborn one-, two-, four-, six- and eight-channel Recording Systems. With a Sanborn you can register permanently and graphically virtually all electrical phenomena within a frequency range of zero to 100 cps. A choice of the number of channels, plus the ready interchangeability of various type preamplifiers (to meet individual recording problems) offers a wider versatility of use, greater overall economy, and increased operating efficiency.

Added to these advantages are the standard SANBORN instrument features: INKLESS recording in true rectangular coordinates, high torque galvanometer movement, time and code marking, and numerous paper travel speeds.

SANBORN COMPANY

INDUSTRIAL DIVISION

CAMBRIDGE 39, MASSACHUSETTS

For more information circle 7 on inquiry card.

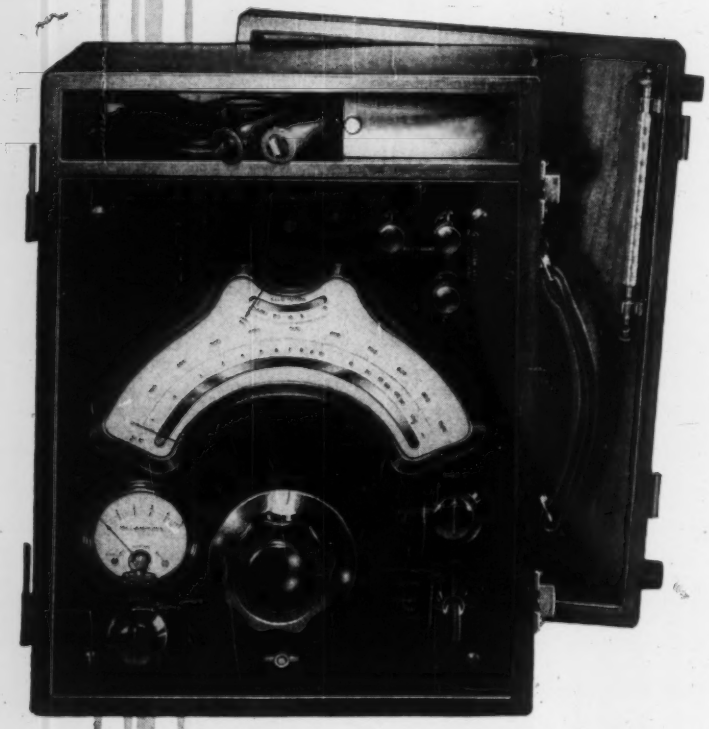
AN ACCURATE, PORTABLE, MULTI-FUNCTION INSTRUMENT

THE LEWIS *PORTABLE* TEST POTENTIOMETER

for Service Testing Exhaust Temperature Measuring Systems

Developed for use by field service engineers of a leading engine manufacturer, the Model 13P05 Test Potentiometer has proven its serviceability in desert heat and arctic cold at maintenance bases on many points of the globe.

FOUR PRECISION INSTRUMENTS IN ONE!



Model 13P05

A PYROMETER-POTENTIOMETER
for measuring exhaust thermocouple temperatures that is truly portable with a sturdy pivoted galvanometer and without a standard cell. Accurate automatic electrically operated cold junction compensation permits this instrument to be used in ambient temperatures from below freezing to plus 120°F. Mirror scales with precise hand-drawn graduations and knife edge pointers insure accurate readings from zero to 1000 degrees Centigrade.

A LOW RANGE OHM-METER
with a widely spaced, hand drawn scale for checking the resistance of leads, thermocouples and balancing resistors to insure correct adjustment to match external resistance requirements of exhaust temperature indicators, either eight or twenty-two ohms.

A KILO-OHM METER,
energized by a 67½ volt battery for checking insulation resistance of lead-wires and thermocouples. Due to the potential applied, this circuit is more effective in detecting flaws than conventional ohm meters. A hand-drawn scale is clearly marked in kilo ohms resistance.

A THERMOMETER TESTER
for precise scale error checks of exhaust temperature indicators having either eight or twenty-two ohms external resistance. A controlled power supply energizes the indicator under test, through the correct series resistance, and the zero to 1000°C temperature scale is used as a reference standard. Recommended for use in adjusting exhaust indicators in accordance with ambient temperature, with power applied for 700°C, through the proper resistance. A liquid-in-glass thermometer and flexible test leads are supplied with each instrument.

For dependable maintenance, use test equipment made by the manufacturer of the components to be checked.

LEWIS ENGINEERING CO.

NAUGATUCK, CONNECTICUT

For more information circle 8 on inquiry card.

Trends...

INSTRUMENTS and AUTOMATION

First Computer Clinic at New York Automation Exposition attracted 200 registrants from 24 industries and 26 states (plus Canada and England). Process men saw control problems solved by use of only transfer functions (no tough equations); factory men saw machine-tool problems solved by computers; business men saw various functions of data processors; all saw primary and intermediate fields of application for all types of computers.

Radioactivity instrument market for 1954 is estimated by "Atomic Energy Newsletter": USAEC and contractors—$6 million; military and government—$9.5 million; private industry—$4.5 million; universities, hospitals and research—$3.5 million; prospectors—$3.5 million; export—$1 million; civil defense—$1 million.

Labor cites automation in request for Guaranteed Annual Wage in auto industry. Does this represent change in attitude? Labor (Murray and Reuther) previously had maintained that a healthy expanding economy could support any degree of automaticity.

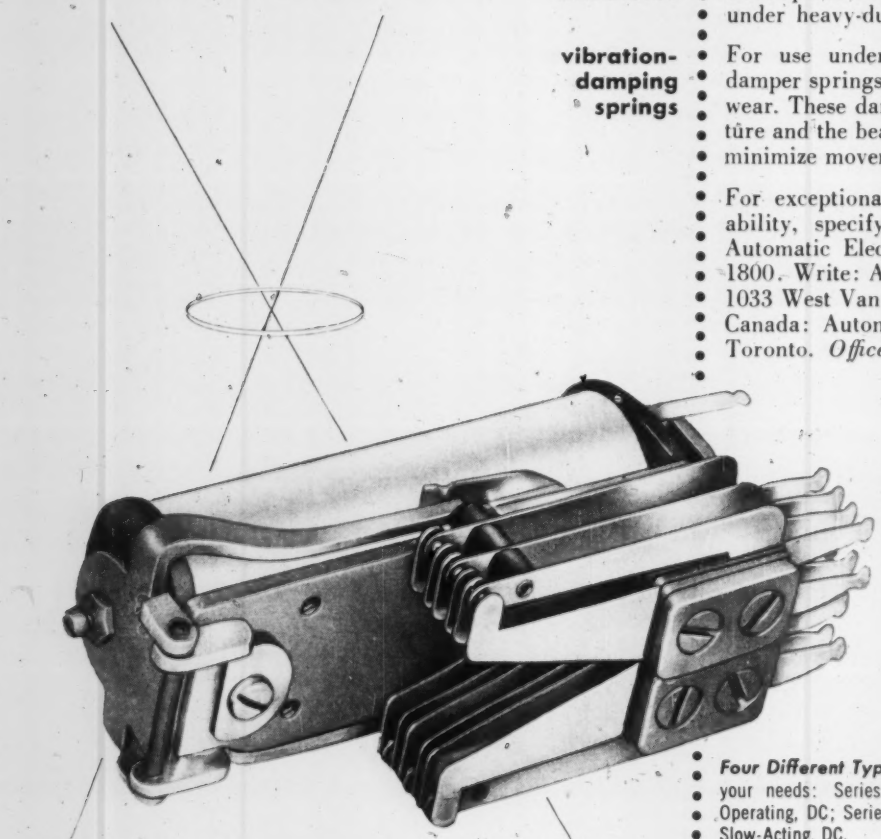
Research expenditures as percentage of sales (reported by SAMA in "Quality Control & Research") range from 5-6% for electrical machinery, instrument, and photographic manufacturers to less than 1% for textiles, petroleum refining, metal, and food industries. Vast potential exists in latter industries.

1955 will feel impact of following fields—graphic circuitry (printed, etched, etc.), new-design germanium rectifiers (will quadruple 1954 volume), solid state devices (ferrites, semiconductors, dielectrics and phosphors), TV satellite and booster stations, and application of information theory. Graphic circuits and transistors will become standard equipment in mass production (Texas Instruments, Inc. announces price reduction of 25-30% on silicon transistors and diodes). Analog computers will find first uses at operational level in continuous process plants in 1955.

Commercial electronics (office computers) will expand from present 8% to 25% of computer sales, and will become a $10 billion market in next 10 years, says W. J. Morlock of General Electric Commercial Equipment Dept.

Highlights of an expanding industry: Robertshaw-Fulton opens $1 million research center at Irwin, Pa.; Grayson Controls Div. of Robertshaw-Fulton is doubling plant size with new $3 million plant at Long Beach, Calif.; American Research Corp. is expanding its Bristol, Conn. plant; Elgin National Watch Co. purchases Neomatic, Inc.; ERDCO Engineering Corp. purchases Mittelmann Electronics; Consolidated Vacuum Corp. moves into new plant at Rochester, N. Y.; Hewlett-Packard moves to a new $500,000 plant building in Palo Alto; Librascope, Inc., opens new 55,000 sq. ft. plant in Glendale, Calif., increasing facilities to 160,000 sq. ft. and 1000 employees; Assembly Products moves to new larger plant in Chesterland, Ohio; The Indikon Co., Belmont, Mass. is new instrument company; G. M. Giannini expands into new quarters at Pasadena; Ketay Instrument and Norden Labs will become Norden-Ketay Corp., with combined sales expected to exceed $20 million annually; Consolidated Engineering opens Buffalo District Office; Kepco Labs opens new 15,000 sq. ft. in Flushing, N. Y.; Helipot opens new Canadian plant; International Resistance Co. purchases Van Dyke Instruments of St. Petersburg, Fla.; Rockwell Mfg. announces new $1 million plant for Russellville, Ky.

Critical inspection welcomed...



Automatic Electric Class "A" Relay

Here's the "workhorse" of the relay industry. Class "A" is a low-cost rugged relay that stands up under critical inspection . . . even after 25 to 50 million operations!

permanently attached contact points

Contact points are resistance-welded—permanently anchored to the spring for the life of the relay. Continual quality checks on the manufacture of the springs assure lifetime service.

exclusive backstop design

Backstop is specially formed to prevent armature freezing and to increase life. A "heavy-duty" armature bearing can be supplied for heavy spring loads or constant high-speed operations; its oversized, hard-metal pin turns in *precision*, long-wearing bearings.

both types of armatures

A choice of "long" or "short" levers gives you the lever ratio required for normal operating and release speeds, or for a residual gap that doesn't vary under heavy-duty conditions.

vibration-damping springs

For use under conditions of extreme vibration, damper springs can be supplied to prevent excessive wear. These damper springs bear against the armature and the bearing pin with considerable pressure, minimize movement due to external forces.

For exceptional performance, sensitivity and durability, specify this outstanding member of the Automatic Electric relay family. Ask for Circular 1800. Write: Automatic Electric Sales Corporation, 1033 West Van Buren Street, Chicago 7, Illinois. In Canada: Automatic Electric Sales (Canada) Ltd., Toronto. *Offices in principal cities.*

class "A" specifications

Four Different Types of Class "A" Relays are available to meet your needs: Series AQA—Quick-Acting, DC; Series ASO—Slow-Operating, DC; Series ASR—Slow-Releasing, DC; and Series ASA—Slow-Acting, DC.

Contacts—Normally single, but can be supplied with twin contacts. Load carrying capacity, 150 watts (maximum 3 amps., non-inductive).

Contact Spring Capacity—Can be supplied with single or double pile-ups. Series AQA and ASO, 13 springs per pile-up; Series ASR and ASA, 6 springs per pile-up. (More contacts can be accommodated at a sacrifice of operating speed and release time delay.)

Dimensions—Overall length, 4". Width, single pile-up—$1\frac{1}{4}$", double pile-up—$1\frac{7}{16}$". Height (depending upon the number of springs), Series AQA and ASO, $1\frac{5}{8}$"-$2\frac{3}{16}$"; Series ASR and ASA, $1\frac{5}{8}$"-2".

For more detailed information, ask for Circular 1800.

RELAYS SWITCHES

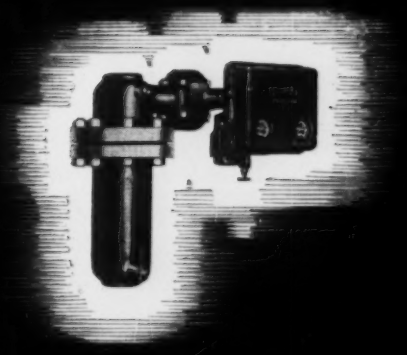
PRODUCTS OF THE INDUSTRIAL DEPARTMENT OF

AUTOMATIC ELECTRIC

CHICAGO

For more information circle 9 on inquiry card.

For more information circle 10 on inquiry card. ⟶



THE DEPENDABLE PERFORMANCE OF **FISHER® LEVEL-TROLS**

IS ESTABLISHED BY THE TENS OF THOUSANDS OF THESE UNITS

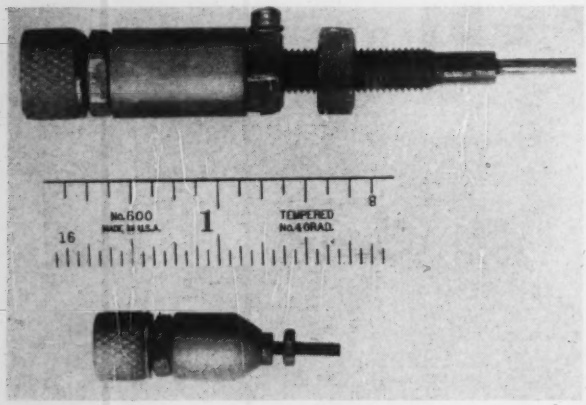
IN WORLD WIDE SERVICE

FISHER GOVERNOR COMPANY • Marshalltown, Iowa

WORLD LEADER IN RESEARCH FOR BETTER PRESSURE AND LIQUID LEVEL CONTROL

Fast-Response Thermocouple

KANSAS CITY, MO.—Development of a new thermocouple of rugged construction which features extremely fast response, used for measuring rapid temperature changes of metal wall surfaces, has been announced by the Engineering Division of Midwest Research Institute.



The thermocouple is applicable for recording temperatures in equipment such as gun bores, cylinder walls, brake drums, etc. A plating of one micron (0.00004 inch) at the junction minimizes the response time; the time required for the junction temperature to reach 63.2 percent of the amplitude of a step change of the exposed surface is approximately ¼ microsecond.

The thermocouple has been tested at pressures up to 60,000 psi. under severe mechanical vibration. Two models have been developed—a small one for use in thin walls and a large one for use in thick walls. The instrument will be made available on essentially an at-cost basis. For further details write Mr. F. N. Stephens, Manager of the Engineering Division, Midwest Research Institute, 4049 Pennsylvania, Kansas City, Mo.

The Meaning of "Automation"

PHILA., PA.—"Automation" has attained acceptance in the lexicon of industry. A survey conducted among engineers, technicians and industrial executives in 10 major industry groups for Minneapolis-Honeywell's Industrial Division found "automation" was the favored word of 82 percent of those questioned when they sought to describe automatically controlled operations.

"Automation," they agreed, signifies "the automatic performance of a controlling function by mechanisms instead of men. This automatic control is obtained through measuring and correcting variables by instruments and mechanisms, with no human intervention. It is not peculiar to any specific industry."

The study covered more than 400 industrialists, diversified as to industry and geographic area. "Automation" embraces, they said: automatic handling of materials; control of temperature, pressure and velocity; automatic processing; assembly of parts; measurement of variables; operation of aircraft, missiles; receiving, storing and shipping functions; computing and data handling; control of household devices; and cost accounting.

The study also revealed that most of the engineers and technicians do not consider "control" to be a part of instrumentation. (The term instrumentation has long been preferred by industrial engineers as a word descriptive of measuring and controlling instruments.) In their opinion, "automation" is the whole of which instrumentation is but a part.

Purdue Uses Computer

LAFAYETTE, IND.—Purdue University became the first college customer of ElectroData Corporation when it took delivery of a high-speed electronic computing system manufactured by the California computer firm. The one and one-half ton electronic brain is slated for installation

in a projected university computing center. Here, in addition to providing tomorrow's men of science with first hand experience in the operation and maintenance of one of industry's newest tools, the ElectroData Computer will solve research and management problems for the various departments of the university and for midwestern industrial organizations. Graduate students specializing in computer technology will also be given the opportunity to participate in computer design and research studies.

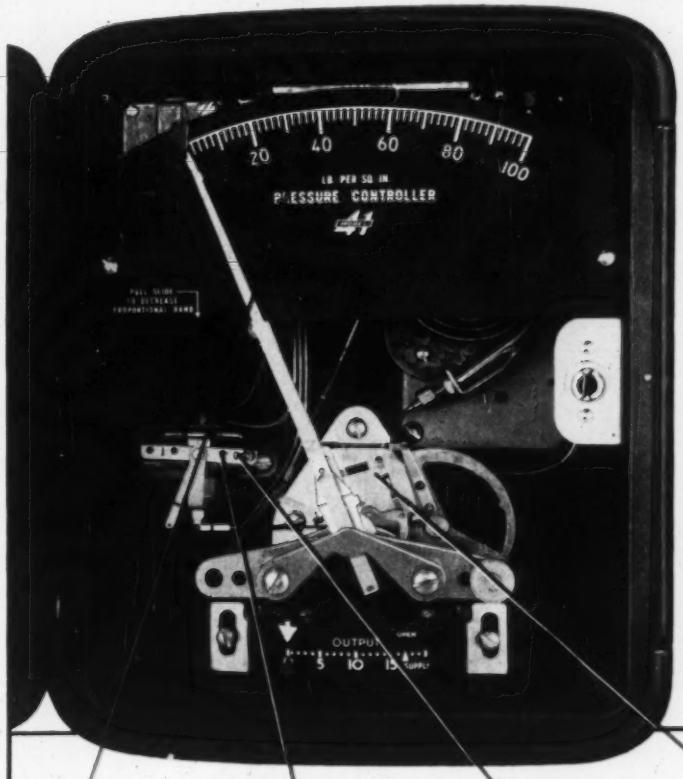
Electronics in Largest Plant

TUSCOLA, ILL.—An extensive electrical temperature transmitting system will control critical processing phases at the world's largest ethylene plant being constructed at Tuscola, Ill., by the Lummus Company.

To be designed and engineered by Minneapolis-Honeywell's Industrial Division, the system will incorporate a host of electronic instruments regulated through a central control panel. The system is believed to be the most complex ever designed for regulation of such "cracking" operations. The new ethylene plant, currently being constructed

Now!
An even BETTER Controller for simple processes!

...the improved Foxboro M/41A Indicating Controller



Here's the Foxboro Controller that proved itself in thousands of successful applications throughout industry! Now, with brand new design features, it's better than ever.

The M/41A Controller offers a new, snappy on-off action, or smooth proportional control action easily adjustable from .25% to 25%. It employs the famous M/40 controller movement — free from backlash, lost motion, and friction. This is a rugged, low-cost, compact controller using standard M/40 parts *throughout* . . . easy to get at . . . easy to service.

For control of simple processes—temperature, pressure, liquid level, or humidity — it will pay you to investigate the convenience and the precise, reliable performance of the Foxboro M/41A Indicating Controller. Write for Bulletin 5A-13.

New Design Features

- Longer Scale — 5" effective length.
- Snappy "On-Off" Control Action on measurement change of only ⅛ of 1% scale.
- Alternate Proportional Action adjustable from ¼ of 1% to 25%.
- "Permaligned" Precision Controller Movement — Exclusive Self-Aligning Ball-Linkage—Non-Backlash Vernier Index Drive
- Simple Rugged Construction—All Parts Easily Accessible

THE FOXBORO COMPANY, 461 NEPONSET AVE., FOXBORO, MASS., U.S.A.

FOXBORO REG. U. S. PAT. OFF. **INDICATING CONTROLLERS**

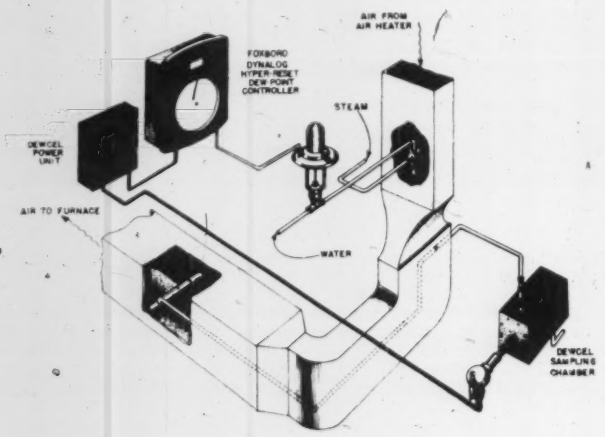
FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

For more information circle **11** on inquiry card.

for the National Petro-Chemicals Corporation, is an $8,000,000 development. Its capacity is estimated at some 600,000 pounds daily.

Dew Point Control

DETROIT, MICH.—A humidification system which controls the dew point of combustion air has been credited by Detroit Edison Company with slowing the formation rate of fireside deposits on the boiler tubes of their stoker-



fired furnaces. The system, which is controlled by a single instrument—a Foxboro "Dynalog Stabilog" Controller—has substantially reduced the number of shutdowns for cleaning and repair.

The moisture content of air from the preheaters is measured by a Foxboro "Dewcel" element which senses the dew point of a continuous sample of air piped to a sampling chamber. The controller receives this dew point measurement, and automatically operates a valve to control flow in the water admission line. The water enters the air ducts in the form of a fine mist sprayed through steam atomizing nozzles. In this manner, the moisture content of combustion air is maintained at a dew point of 79 deg. F., proved by tests to produce an optimum low rate of fireside deposit formation. Descriptions of the sampling system, "Dewcel" element, and controller are contained in new Application Engineering Data Sheet, AED 823-13, available on request from The Foxboro Company, Foxboro, Mass.

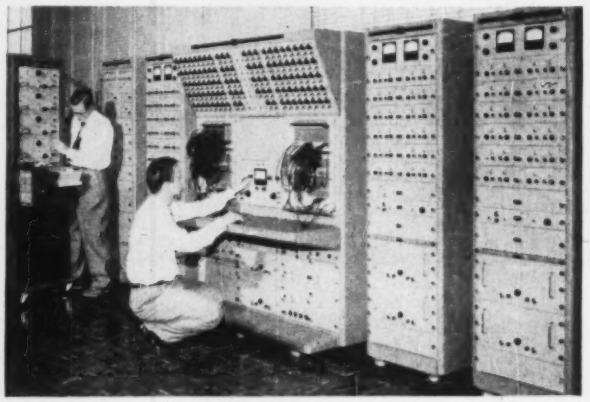
Subzero Thermometry

SCHENECTADY, N. Y.—At the ninth annual calorimetry conference held at the General Electric Research Laboratory, attended by 130 scientists from the United States, Canada, and Europe, a recommendation was unanimously passed requesting establishment of an accurate temperature scale extending below the boiling point of oxygen. This recommendation now has been placed before the National Bureau of Standards, the ultimate authority in this country on thermometers, their scales, and their accuracy.

Temperature ranks with mass, length, and time as one of the most basic of physical quantities. Modern researchers studying the behavior of various materials—electrically, chemically, and physically, at low temperatures—have pushed their studies to within a fraction of one degree of absolute zero (minus 459.70 deg. Fahrenheit). Liquid oxygen at –297.4 F., liquid nitrogen at –320.4 F., liquid hydrogen at –422.9 F., and liquid helium at –452 F. are common research "tools."

New Computer Center

SANTA MONICA, CALIF.—An analog computation center for the Los Angeles area was opened September 1st at the J. B. Rea Company Plant, 1723 Cloverfield Blvd., Santa Monica, to fill the need for a computer facility available to

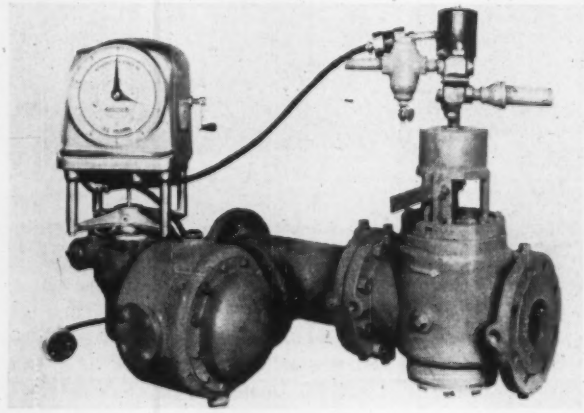


industry to solve problems in simulation, dynamic system analysis, and application engineering, as well as to serve numerous military installations in their problems of data reduction and other analytical solutions.

The computation equipment, manufactured by Electronic Associates, Inc., includes a dual control console, 72 operational amplifiers, 6 servo-multipliers, 6 function generators, and a 4-channel recorder. For the past year the J. B. Rea Company has also had an IBM CPC digital computer service available. Thus the J. B. Rea Company offers both an analog and a digital computing facility to industry and military users.

Automated Batching

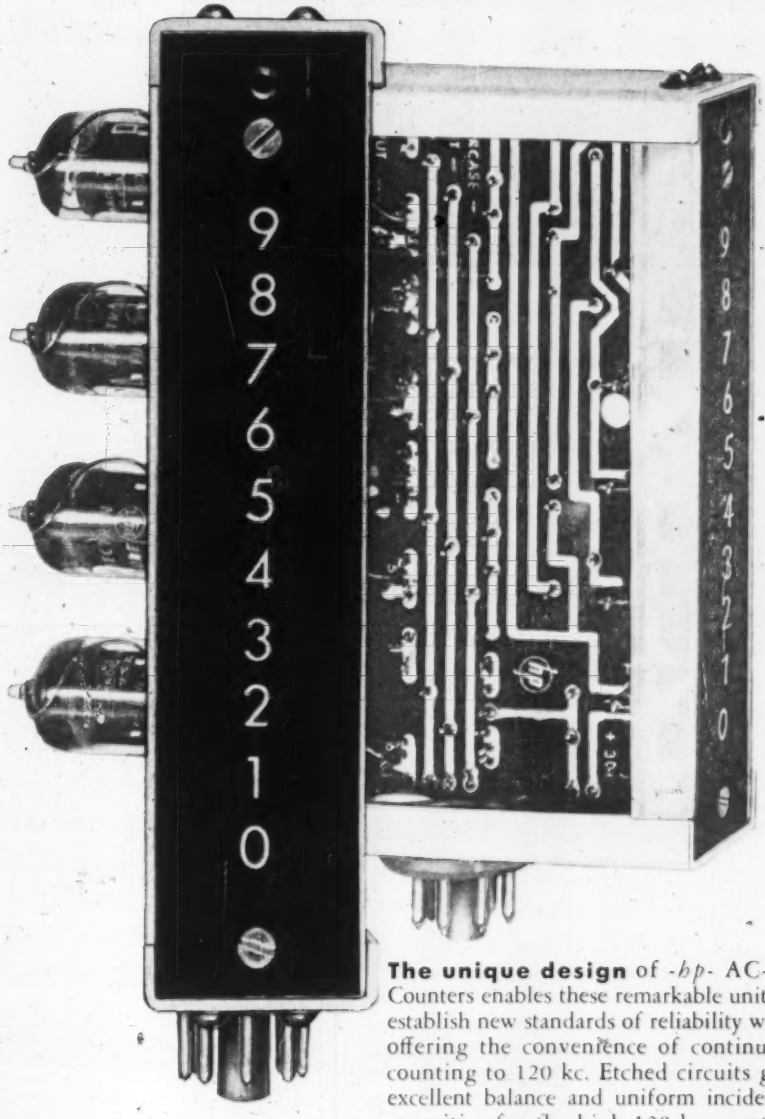
INDIANAPOLIS, IND.—Economies of automation have been applied to the handling of light and heavy liquids in batch quantities through the "Fluidometer System" developed by Hetherington and Berner, Inc., of Indianapolis,



Ind. It consists of a Rockwell "Rotocycle" measuring element, a motor-operated control register, and a solenoid valve.

To operate, a control dial is set to the desired amount of liquid to be passed through, and a "start" button is pushed

Presenting hp AC-4A
DECADE COUNTERS



120 kc counting rate

Will operate recorders

Low cost, high reliability

Brilliant numerals

Labeled, etched circuits

Low temperature operation

Fits all standard counters

Ideal for special purpose applications

The unique design of *-hp-* AC-4A Counters enables these remarkable units to establish new standards of reliability while offering the convenience of continuous counting to 120 kc. Etched circuits give excellent balance and uniform incidental capacities for the high 120 kc counting rate. A staircase output voltage proportional to count is available to operate recorders or external equipment using coincidence detectors. The circuit is completely visible, accessible, labeled and arranged diagrammatically. Mechanical layout permits maximum ventilation—lower temperatures and longer life. Optically engineered illuminated numerals are clear, bright, easy to read under all conditions.

***-hp-* AC-4A Counters** are recommended replacement units for *-hp-* 522 and 524 series Electronic Counters; and are ideal for experimental and special applications.

Write for details

HEWLETT-PACKARD COMPANY

3218C Page Mill Rd. • Palo Alto, Calif., U.S.A.
Export: 275 Page Mill Road, Palo Alto, Calif.
Cable: "HEWPACK"

Sales engineers in all principal areas

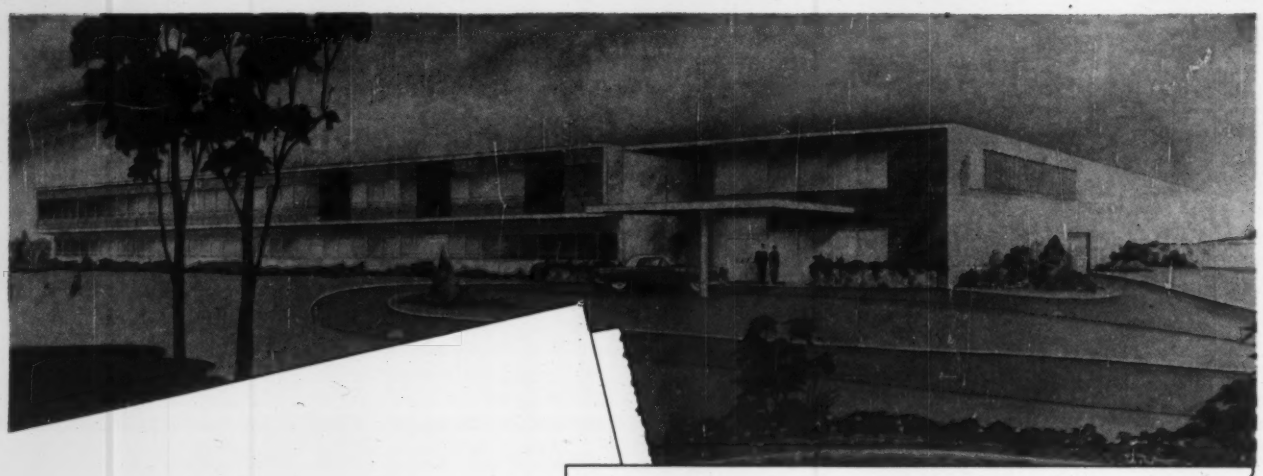
SPECIFICATIONS

Counting Rate: 120 kc max.
Double-Pulse Resolution: 5 μsec
Input: Approx. 80 v neg.; 1 μsec rise time
Output: Approx. 80 v neg. to drive succeeding counter
Reset: To 0 or 9
Staircase Output: 135 v at 0, 55 v at 9. Internal resistance 700 K
Size: 5⅝" deep, 1¼" wide, 6⅛" high. Weight 1 lb.
Mounting: Standard. Fits octal socket
Price: $45.00.

Data subject to change without notice. Prices f.o.b. factory

hp INSTRUMENTS ***Complete Coverage***

For more information circle **12** on inquiry card.



Midwestern Geophysical Laboratory
of Tulsa, Oklahoma

takes pride in announcing that effective January 1, 1955
our new name will be

Midwestern Instruments

Midwestern Instruments will carry on,
as did Midwestern Geophysical Laboratory,
as one of the leaders in the field of
Instrumentation and Control Systems

With its new and greatly expanded facilities, Midwestern Instruments will accelerate its design and manufacturing endeavors in the general fields of instrumentation and automatic control systems. We invite the submission to us, of problems in recording dynamic information in both airborne and ground-based applications, as well as problems concerned with automatic control, particularly those of reasonably high power level and dynamic performance requirements where hydraulic servosystems are at their best.

Write or wire for further information.

Products

- OSCILLOGRAPHS (LABORATORY AND FLIGHT TEST)
- MAGNETIC STRUCTURES
- GALVANOMETERS
- AMPLIFIERS
- HYDRAULIC SERVOVALVES
- TORQUE MOTORS
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- WATERPROOF CONNECTORS
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MIDWESTERN INSTRUMENTS

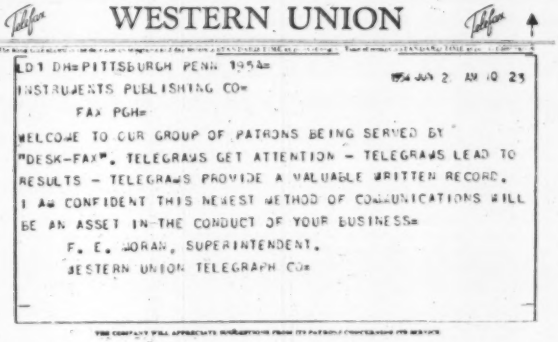
MIDWESTERN INSTRUMENTS
41st and Sheridan Road — Tulsa, Oklahoma

For more information circle **13** on inquiry card.

which opens the valve and allows the liquid to pass through the meter. The meter drive shaft is directly coupled to the control and turns the hands to the zero point. At zero, the controlling element automatically closes the valve and returns the hands to the previous setting. Accuracy of 0.5 percent has been attained in an asphalt plant.

Automatic Telegrams

PITTSBURGH, PA.—Western Union now delivers its telegrams automatically and rapidly by installing "Desk-Fax" at plants and businesses that receive telegrams in a number sufficient to warrant use of this new method of communications.



WESTERN UNION

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WELCOME TO OUR GROUP OF PATRONS BEING SERVED BY
"DESK-FAX". TELEGRAMS GET ATTENTION - TELEGRAMS LEAD TO
RESULTS - TELEGRAMS PROVIDE A VALUABLE WRITTEN RECORD.
I AM CONFIDENT THIS NEWEST METHOD OF COMMUNICATIONS WILL
BE AN ASSET IN THE CONDUCT OF YOUR BUSINESS=
F. E. MORAN, SUPERINTENDENT.
WESTERN UNION TELEGRAPH CO=

RR Yard Control

NORTH PLATTE, NEB.—An electronic device for directing guided missiles now directs freight cars. Union Pacific Railroad has demonstrated a system at its retarder yard at North Platte, Neb. that switches and controls the coupling speeds of freight cars automatically. Developed jointly by the Railroad and Reeves Instrument Corporation, a subsidiary of Claude Neon, Inc. of New York, this is the first full-train application of automatic switching and car retarding control on any railroad freight classification yard. It is considered by railroad officials as a major advancement in push-button railroading.

Called the "electronic yardmaster," the system is expected to virtually eliminate impact damage to boxcar loading resulting from errors in human control of freight car handling in retarder yards. While the pilot system now in use at the retarder yard provides for routing only to eight tracks, the completed project will provide automatic controls for all 42 tracks of the yard which handles as many as 4,000 freight cars in 24 hours.

A long string of freight cars can be pushed up over the hump of the huge classification yard and, as they are uncoupled and start their descent down the incline to the various tracks of the yard, the switching and control of their speed is done automatically.

As the freight cars roll down the incline the rolling characteristics of the cars are determined electrically and then transmitted to the electronic "brain" as the "rolling coefficient." The distance the car has to roll to couple with other cars standing on the classification tracks, which may be two-thirds of a mile, is computed and also fed to the "brain" by an electronic device.

EPLAB

PYRHELIOMETER
For the Measurement of
SOLAR RADIATION

Eppley Pyrheliometers are used for solar radiation measurements at ninety-eight weather stations in the continental United States, Canada, Alaska, Greenland, Iceland, Caribbean Sea, and the Pacific Ocean. Sixty-two of these stations are under the direction of the United States Weather Bureau.

The Eppley Pyrheliometer was adopted as standard equipment by the Weather Bureau after considerable experimentation. It was found to be the best instrument so far tested by the Bureau.

Used in conjunction with a suitable recorder, the Eppley Pyrheliometer will provide an accurate and reliable record of total solar and sky radiation on a horizontal surface.

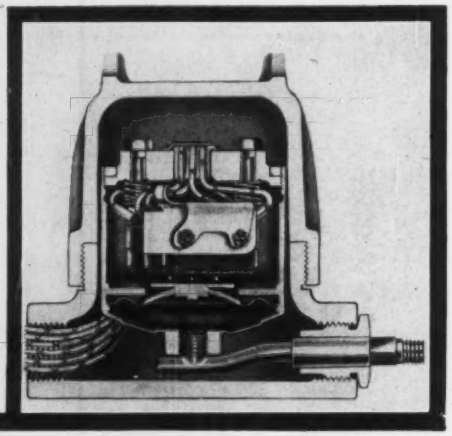
Bulletin No. 2 on Request

THE EPPLEY LABORATORY, INC.

Scientific Instruments

2 Sheffield Ave.
Newport, Rhode Island U.S.A.

New Improved

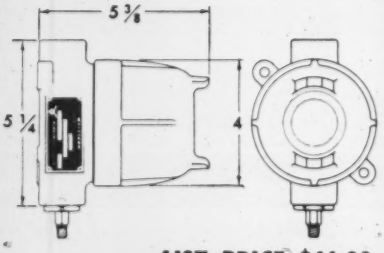


MELETRON PRESSURE SWITCH

for Explosive Atmospheres

- **LOW COST** *because of design simplicity*
- **SMALL and COMPACT** *for easy installation*
- **EXTREME ACCURACY** *moving and wearing parts are eliminated*
- **NOT AFFECTED BY VIBRATION** *no liquid switching elements are used*
- **RUGGED and WEATHER RESISTANT** *enclosed in a crouse-hinds case*
- **EASILY ADJUSTABLE** *by convenient adjusting nut*
- **OPERATES IN ANY POSITION** *saves installation time*

ACTUAL SIZE



LIST PRICE $46.20

BARKSDALE VALVES

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send FREE operating and engineering data sheets 920-25

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COMPANY _____

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CITY _____ ZONE _____ STATE _____

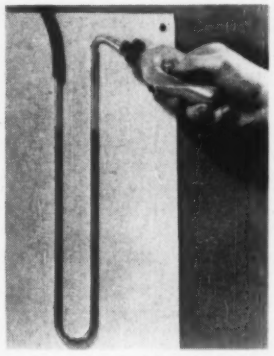
For more information circle **15** on inquiry card.

Fast Response Pressure Gage

CHICAGO, ILL.—A miniature gage has been developed at Armour Research Foundation of Illinois Institute of Technology, 35 W. 33 St., Chicago 16. The pressure gage, probably the smallest of its kind ever made, can measure pressures as low as those from a breeze to those that would demolish the sturdiest of buildings. The sensitive probe of the gage measures one-eighth inch in diameter. One of the gage's most important characteristics is its rapid response; the response is measured in millionths of a second.

The sensing part of the gage consists of a tiny tube of piezoelectric ceramic material, barium titanate.

Mercury Dispenser

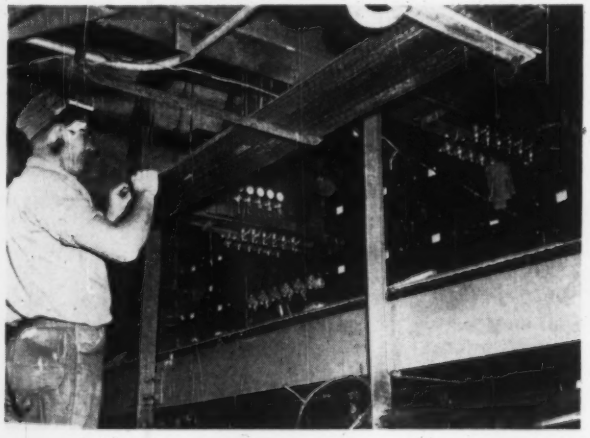


ROCHESTER, N. Y.—Testing fuel pumps and carburetors at Rochester Products, Division of General Motors, requires frequent dispensing of mercury into manometer tubes. Use of a collapsible polyethylene bottle as both container and dispenser of the mercury proved ideal.

As a result of this success with the collapsible polyethylene bottles as mercury dispensers, Rochester Products also uses them for strong acids, bases, poisonous solutions and inflammables up to 50 C.

Pneumatic Lines

ROME, GA.—Similar to the intricate wiring pattern of an automatic telephone exchange appears this control pipe system under the control room of the Georgia Power



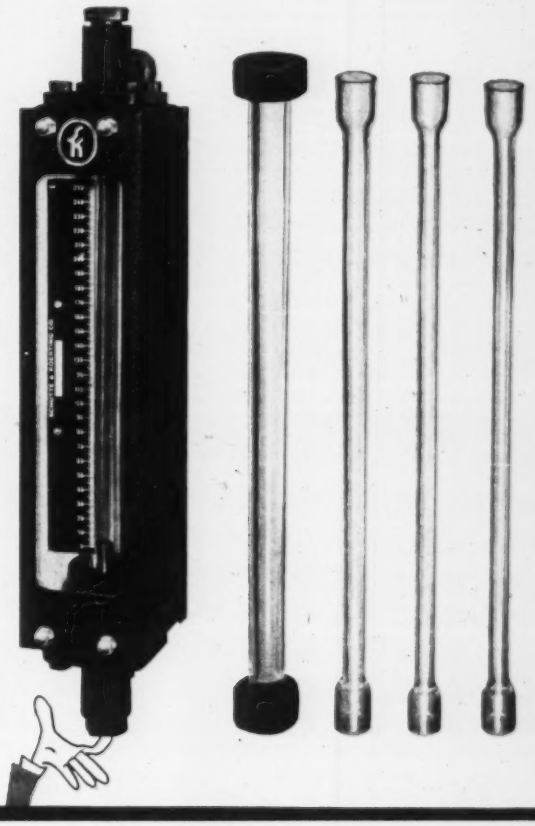
Company's new Plant Hammond at Rome, Georgia. More than 100,000 feet of pipe are used on instruments alone that control the steam supply for the 300,000-kw. plant. The entire power piping system, fabricated and installed by Blaw-Knox Company, Pittsburgh, consists of 250,000 feet of pipe, ranging in size from ¼ inch to 24 inches.

Micro Drilling

LOS ANGELES, CALIF.—Micro drilling, or the drilling of precise holes smaller than number-60 drill size, is an operation which is becoming more common in fine

The versatile ROTAMETER for continuous or batch processing

wide range of capacities within one meter size lets you measure flow under changing conditions



Ever wish for a *versatile* meter? One that adapts *in minutes* to changing rates of flow? You get your wish *with the SK Safeguard Rotameter because . . .*

. . . *Four Sizes of Tubes*, each offering a different capacity, can be used in a single Rotameter.

. . . *Tubes Interchange Quickly*—can be removed and replaced to meet changing conditions.

. . . *Exclusive Belled Ends* of tubes, all having same inlet and outlet OD, permit standardization of end fittings and packings. No special tools or fittings needed.

. . . *Numerous Rotor Designs* can be used within one meter tube to provide wide range of capacities.

Where flow rates change frequently, as in proportioning dissimilar fluids, you'll find the *SK Safeguard Rotameter* outstandingly convenient and economical. Accurate, durable and safe, too, because . . .

. . . Meter Case of Strong, Rigid Steel completely encloses tube—protecting against external shock, acting as a safeguard should tube break accidentally.

. . . Heavy Gauge, Safety Glass Windows provide excellent view of tube, rotor and scale.

. . . Detachable Metal Reference Scale is clearly marked for easy reading—can be supplied in units of flow, or in millimeters for use with calibration charts.

. . . Bronze, Cast Iron or Stainless End Fittings are designed to permit connection to piping in any of four horizontal positions.

. . . Non-leaking, Seated, Clean Out Plugs at top and bottom of end fitting permit rotor removal and tube cleaning without disassembly.

. . . Packing Glands are adjustable from outside of case by means of stainless steel capscrews.

Get Your Free Copy of Bulletin 18-RG. It details operating principles, sizes and dimensions, construction features of SK's Safeguard Rotameter. Yours without obligation.

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Oil Burning Equipment • Rotameters
Flow Indicators • Radiafin Tubes • Valves
Spray Nozzles and Atomizers • Gear Pumps
Desuperheaters

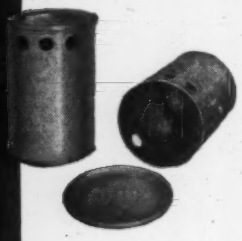
For more information circle **16** on inquiry card.

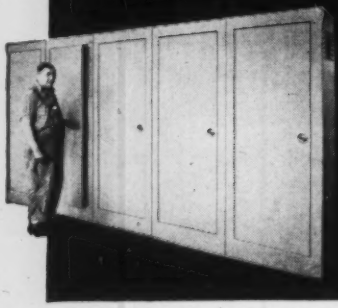
CUSTOM BUILT

Electrical Enclosures

BY

KIRK AND BLUM





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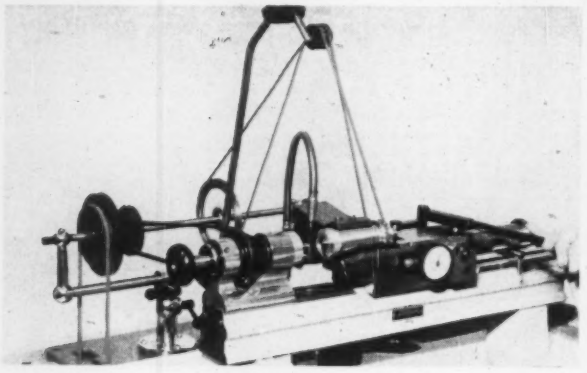
METAL FABRICATION

For more information circle **17** on inquiry card.

instrument work. The sizes of the holes are constantly decreasing. In this area even making a proper center to start a drill becomes a problem.

The drilling apparatus shown was developed primarily for micro-drilling operations. It has been successfully used for drilling holes as small as 0.0016 inch and does

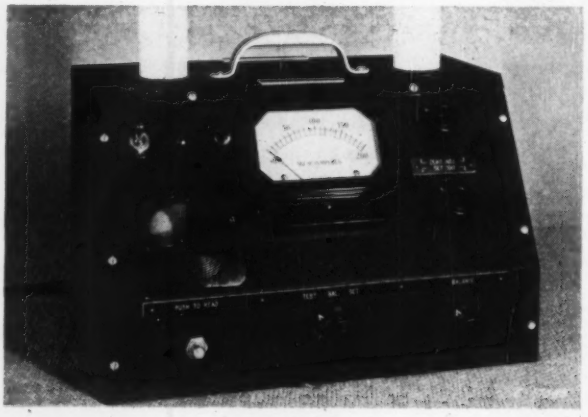


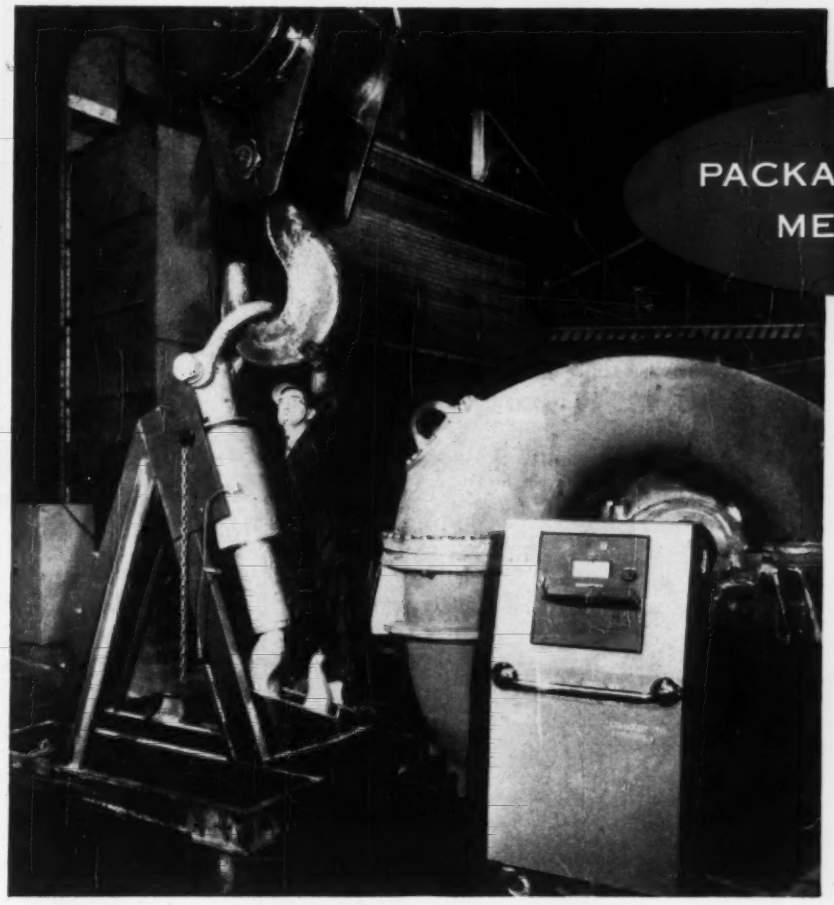
not require any unusual skill of the operator. As an example of work done with it, a 0.023-inch hole was drilled through a piece of drill rod 1.062-inch long, and the total indicator runout was less than 0.0002 inch.

Since much of the work done with the drilling attachment is done without centering, it is advisable to use the so-called "pivot drills," or watchmakers' drills. This type of drill has an oversize shank and is exceptionally rigid for its size. When the depth of the hole exceeds the length of the flutes of a pivot drill it is used only for starting the hole; the hole is then finished with a regular twist drill. Of course, if the hole is smaller than the smallest commercially available twist drill, then there is no recourse but to use a pivot drill, and the depth is limited by the length of the flutes. Bulletin N, giving a complete description of the drilling attachment and micro-drills, may be obtained from Louis Levin & Sons, Inc., 3610 South Broadway, Los Angeles 7, Calif.

Lamp Life Prediction

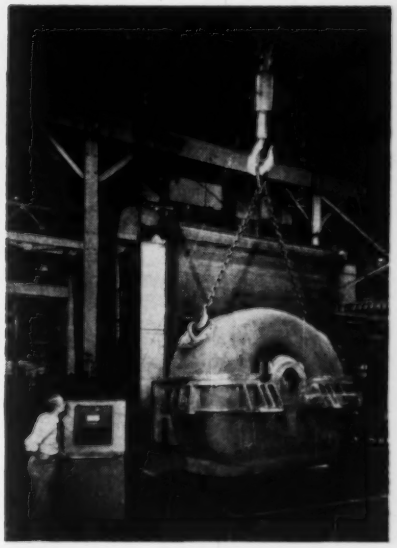
CLEVELAND, OHIO—Pictured is the electronic instrument by which General Electric engineers estimate the life of a fluorescent lamp by "weighing" the amount of chemical on the cathode. The lamp being tested is compared with a lamp having an uncoated cathode. When the current is applied, the coated cathode is slower to





PACKAGED PRECISION MEASUREMENT

Weight is measured in SR-4 crane scale in swivel hook (shown resting in cradle at left) and weight is indicated remotely on mobile indicator (right foreground in picture at left). Photograph below shows actual weighing operation.



A leading manufacturer of electrical equipment cuts weighing costs by 12% with accurate, remote-indicating SR-4® Crane Scale

At a leading manufacturing company of electrical equipment, a Baldwin SR-4 Crane Scale has decreased annual weighing costs by 12%. The crane scale is used to weigh accurately huge turbines, generators and propulsion gears while they are being moved on 50 ton capacity cranes. Accurate weight measurement is important information for planning shipment of the equipment and its installation at the eventual site of operation.

This company's materials handling section found their SR-4 Crane Scale gave them these five important, cost-cutting advantages over their previous, beam-balance, method of weighing:

1. *Greater Accuracy*—The SR-4 Crane Scale has been tested for accuracy of 0.2 percent measuring loads from 850 lbs. to 34 tons.

2. *Greater Capacity*—The SR-4 unit can weigh anything up to the limits of the 50 ton cranes on which it is used.

3. *Convenience*—Remote indicating of weights simplifies weighing operations . . . saves valuable time and manpower.

4. *Interchangeability*—The SR-4 unit is interchangeable between all of the cranes in operation. Thus, one unit performs a multitude of weighing operations.

5. *Lower Maintenance*—Maintenance is limited almost exclusively to simple greasing of the swivel hook.

You, too, will profit when you use *Baldwin Packaged Precision Measurement* to simplify operations, save you time and money . . . in any measurement of load, fluid pressure or torque. You'll benefit by sending today for our illustrated bulletins which will give you complete detailed information. Address Dept. 3315, Baldwin-Lima-Hamilton Corporation, Philadelphia 42, Pa.

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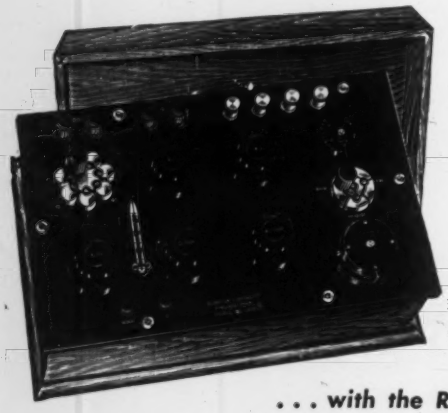
Precise
TEMPERATURE MEASUREMENTS

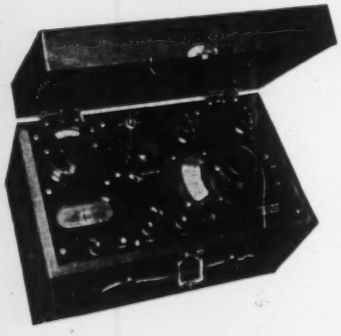


. . . with the Rubicon MUELLER BRIDGE

A highly accurate and specialized form of the Wheatstone bridge designed expressly for precise resistance thermometry with three- or four-lead thermometers and for the measurement of other similar resistors within its range.

- Wide range: 0 to 141.1110 ohms in increments of 0.0001 ohm
- Unity ratio with provision for convenient checking and precise adjustment of ratio arms
- Built-in mercury commutator for lead resistance compensation
- Sub-panel switch construction
- Built-in plug and block assembly for conveniently checking ratio, bridge zero and thermometer resistance with no disturbance of external bridge connections

Described in Bulletin 100



. . . with the Rubicon PORTABLE PRECISION POTENTIOMETER

A two-dial instrument of exceptional accuracy and sensitivity.

- High-sensitivity, sturdy, built-in Pointerlite galvanometer—permits balancing to within 2 microvolts in low resistance circuits
- Completely self-contained assembly—no external accessories except the thermocouple circuit
- Two ranges —0 to 16.1 and 0 to 161 millivolts—readable to within 2 and 20 microvolts respectively
- Sturdy, compact construction for long dependable service

Described in Bulletin 270

RUBICON COMPANY
Electrical Instrument Makers
3755 Ridge Avenue Philadelphia 32, Pa.
For more information circle **19** on inquiry card.

increase in temperature. The difference in resistance to heating is roughly proportional to the weight of the chemical, and can be read on the indicator. Other things being equal, the life of a fluorescent lamp depends upon the amount of chemical held by the cathode.

Instrument Servicing

CHICAGO, ILL.—Removal of glass or plastic gage-covers during instrument servicing and repair is sometimes made difficult by the cover seizing or sticking. In many instances the sealing gasket is destroyed in the

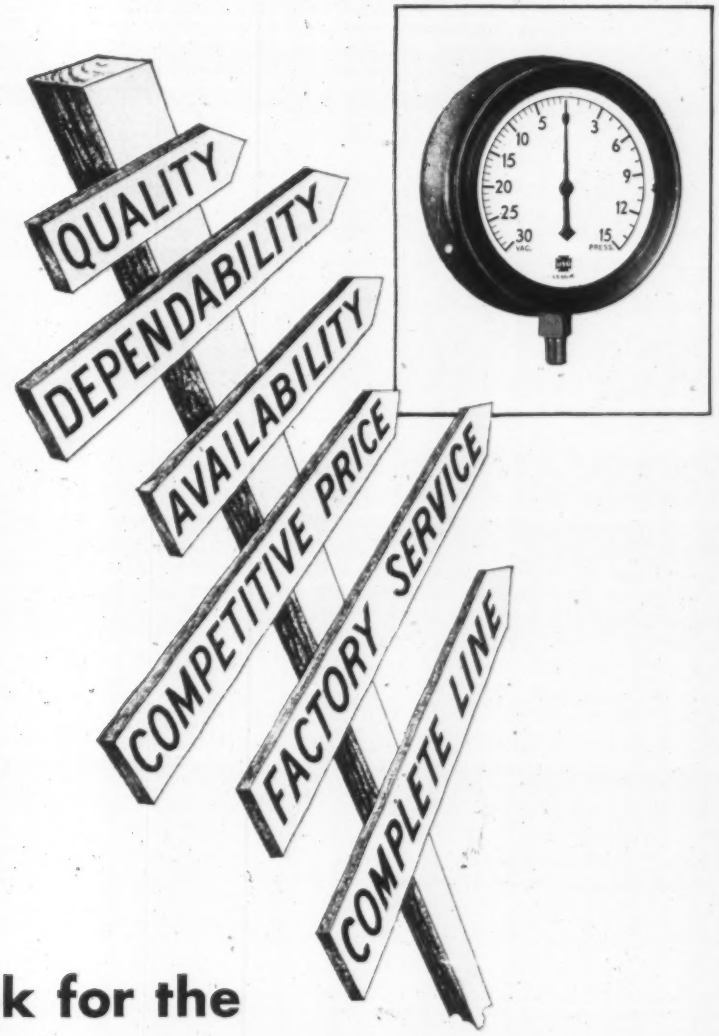
process, and a replacement is necessary. When the gage must be absolutely air-tight, it is particularly important that the gasket be in perfect condition.

The F. W. Dwyer Manufacturing Company, Chicago, got around this problem by using Acheson Colloids Company's "Aquadag," a dispersion of colloidal graphite in water. "Aquadag" plays an important part in the assembly of Dwyer's Magnehelic Gage. A small amount of "Aquadag," brushed on the sealing gasket where it is adsorbed, forms a microscopically fine release coating and sealing film, permitting the cover to be slipped off with a slight twist, even though the fit is tight enough to afford positive protection against leakage.

Physiological Monitor

WASHINGTON, D. C.—National Bureau of Standards has developed an electronic instrument which automatically detects changes in the physiological condition of a patient under anesthesia throughout the course of an operation. Known as the NBS Physiological Monitor, this instrument measures changes in the patient's blood pressure, heart beat, and respiration and presents the data on a panel for interpretation by the surgeon or anesthesiologist. A permanent record of the patient's condition during the operation is provided by a recording device.

Because the Physiological Monitor provides a continuous indication of the patient's physiological condition during surgery, it should prove of value in prevention and control



Look for the USG Plus Factors when buying gauges

Over and above mechanical features—*quality* . . . assurance of sustained high accuracy . . . long, trouble-free service . . . are most important. But, availability and price are also important.

When you buy USG gauges, you're assured guaranteed satisfaction in enduring accuracy, performance, dependability and price. For over 50 years, USG gauges have been renowned for their high accuracy and dependability—more original equipment manufacturers specify USG than any other make.

USG stocks for your convenience over 200,000 standard gauges of all types. See your USG Distributor for all your gauge requirements. More than likely, he can supply you with any quantity of gauges you want for any application, directly from his stock.

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Gauge Headquarters
for over 50 years

United States Gauge, Division of American Machine and Metals, Inc., Sellersville, Penna.

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USG'S MODERN RESEARCH LABORATORY HELPS INDUSTRY CUT GAUGE COSTS

Quality, accuracy, immediate availability, price—these are important factors in gauge buying.

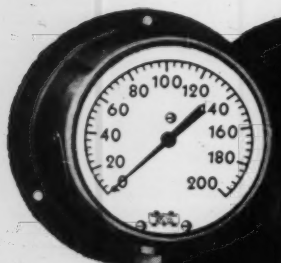
Equally important, however, is assurance that gauges will perform with lasting dependability. USG provides that assurance by testing under simulated operating conditions in its Research Laboratory. Annually, these USG tests save customers hundreds of thousands of dollars in superior operating performance and less down time, not to mention eliminating more frequent gauge replacements.

Constant testing of materials under all kinds of operating conditions and pressures is one of the many reasons why USG gauges are renowned for their enduring accuracy and dependability. USG assures this accuracy and dependability in lot after lot by employing in its manufacture the most rigid quality control system in the instrument industry.

Higher quality gauges at competitive prices are made possible by USG because its facilities are economically integrated for large volume quality-controlled production. It provides further savings to industry by stocking the world's largest, most complete line of gauge components to meet practically any pressure sensing and indicating need. From these components USG engineers often make special gauge designs, at practically stock costs, to meet individual operating conditions.

Gauge for gauge—in every application classification—*in every price class*—USG has more to offer than any other make gauge.

Above, a portion of USG's Research Laboratory. Here constant testing of materials under customer operating conditions assures optimum efficiency and long gauge life.



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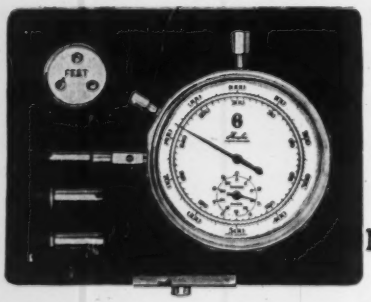
HASLER SPEED INDICATOR
Chronometric Tachometer with separate reset button for cumulative readings



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Durable
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Size
2¾" x ⅞" x 4"
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ready for test

Type A 0-20,000 r.p.m.
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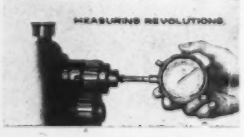
Shipment within 5 days from stock

All instruments serviced by



HASLER—TEL COMPANY,
28 Vesey Street, New York 7, N. Y.
U.S. Distributors for Hasler Speed Indicators since 1919

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of emergencies at the operating table or during certain critical postoperative periods. The instrument is also expected to be a distinct aid in those phases of medical research—such as studies of the effect of drugs on blood pressure—that require a knowledge of the behavior of physiological variables over long periods.

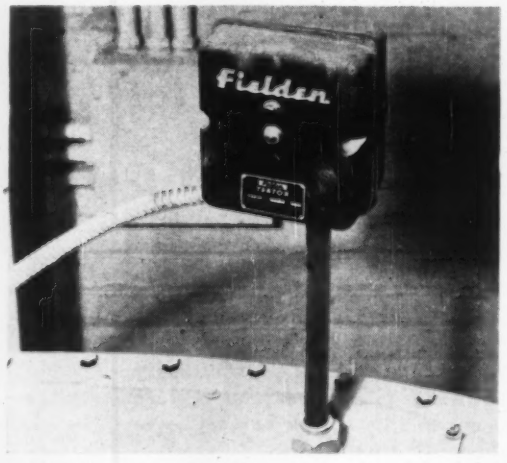
Development of the Physiological Monitor was carried out by S. R. Gilford and H. P. Broida of the NBS staff.

Selenium Rectifiers

NEW HAVEN, CONN.—Selenium rectifiers which show no indication of failure or decrease in output after more than 1000 hours at 150 C. are now being built experimentally by Bradley Laboratories, Inc., New Haven, Conn., producers of selenium and copper oxide rectifiers.

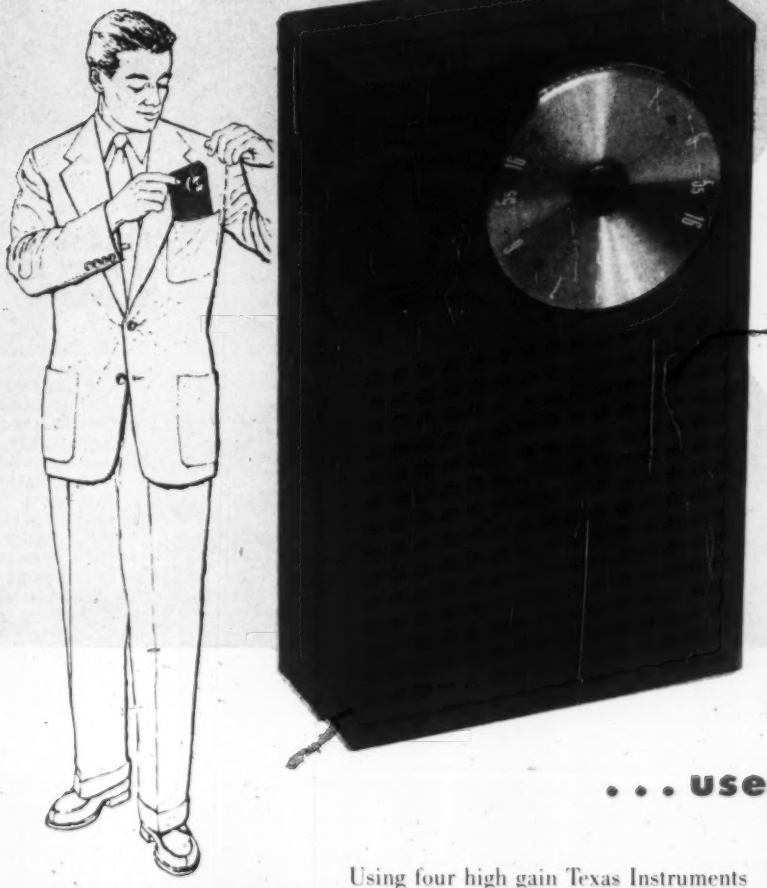
Flour Level Control

DETROIT, MICH.—Awrey Bakeries, Inc., Detroit, is using a new electronic instrument—the Fielden "Tektor"—to control the level of flour in a large holding tank. The light, fluffy and nonconductive nature of flour makes the



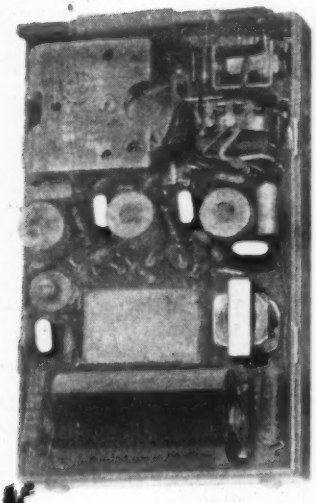
use of other types of level control equipment unsatisfactory. The electronic device uses a metal sensing probe. When the air surrounding the sensing probe is displaced by a material of a higher dielectric character (flour), a signal is produced at the instrument.

Control with an accuracy of plus or minus one percent is attained. The probe has a built-in RF oscillator using one standard radio tube. The instruments are supplied in a variety of weather-resistant, dust-tight, and explosion-proof cases. The "Tektor" is a product of Fielden Instrument Division, Robertshaw-Fulton Controls Company, 2920 N. Fourth St., Phila., Pa.



the First transistorized consumer product

. . . uses TI transistors!



With four Texas Instruments grown junction n-p-n germanium low cost, high gain transistors, the Regency radio achieves power gains of 32 decibels in each intermediate-frequency stage and 37 decibels in the audio stage. One transistor is used as a combination mixer-oscillator, two as intermediate-frequency amplifiers, and one as an audio amplifier. Output transformer also TI manufactured.

Using four high gain Texas Instruments transistors, the world's first transistorized consumer product — a high performance pocket size radio — is now available on the retail market! Priced under $50, the world's smallest commercial radio receiver (manufactured by Regency of Indianapolis) achieves better performance than many much larger conventional sets. To produce the specially designed transistors used in this superb little instrument, TI has developed advanced manufacturing techniques that assure uniformly high product quality as well as mass production quantities.

With the transistor radio already a reality, the multi-million dollar consumer market is ready and waiting for still more transistorized products. Don't delay your own product development for lack of suitable low cost, high performance transistors. In designing transistorized products, depend on transistors from Texas Instruments, a leading supplier of transistors for a variety of commercial and military applications. Producing the industry's widest range of semiconductor devices — silicon or germanium; diodes or transistors — Texas Instruments is your most *experienced* source of supply for dependable semiconductor products.

TEXAS INSTRUMENTS
INCORPORATED
6000 LEMMON AVENUE DALLAS 9, TEXAS

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PROVEN by 8 years

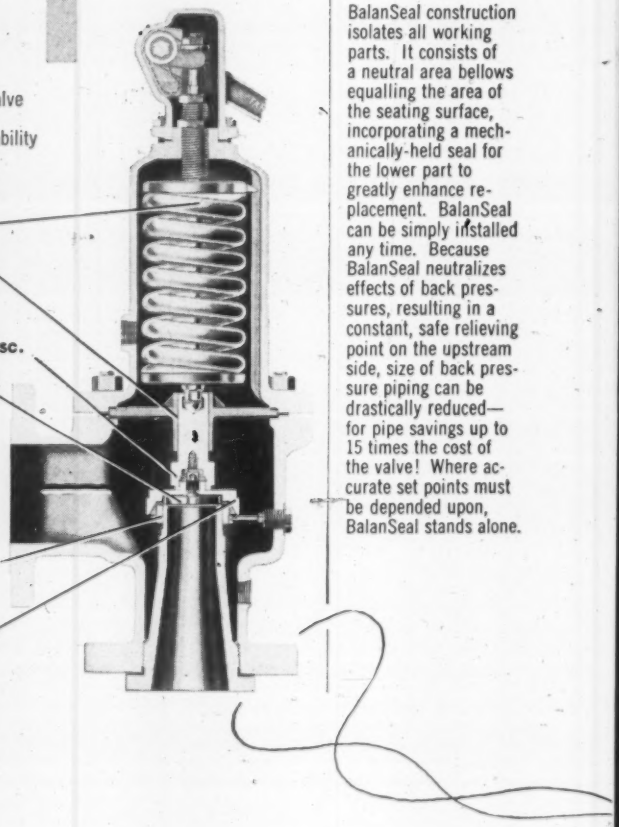
THOUSANDS of Successful Installations of Farris "4 in 1" Safety Relief Valves*

NOTICE: Farris Safety Relief Valves, the Internal Heat Exchanger, and Bellows construction are covered by U.S. Patents and Patents Pending. Copyrights, where applicable, are registered.

1 STANDARD FULL NOZZLE SAFETY RELIEF VALVES

Here is the ultimate in nozzle valve construction with complete standardization and interchangeability in every part:

- Round wire springs calibrated for rating.
- 2½ to 1 guiding ratio, close tolerances.
- Alignment spool for perfect alignment and bearing from stem to disc.
- Self-aligning, optically-flat replaceable disc of forged Stainless Steel.
- All bearings of hardened Stainless Steel.
- Expanded orifices increase capacity.
- Single blowdown ring does not affect capacity —simple adjustment.
- Flared disc-holder for ultimate operating efficiency.



BALANSEAL© SAFETY RELIEF VALVES

BalanSeal construction isolates all working parts. It consists of a neutral area bellows equalling the area of the seating surface, incorporating a mechanically-held seal for the lower part to greatly enhance replacement. BalanSeal can be simply installed any time. Because BalanSeal neutralizes effects of back pressures, resulting in a constant, safe relieving point on the upstream side, size of back pressure piping can be drastically reduced—for pipe savings up to 15 times the cost of the valve! Where accurate set points must be depended upon, BalanSeal stands alone.

For eight years Farris has been setting-the-pace-in-safety with "4-in-1" Safety Relief Valves, the "standard" for long service life, minimum maintenance and positive protection.

Farris' recognition as the pace-setter of the industry is no accident, but the result of many engineering "firsts" in improved valve design—FIRST with balanced bellows construction . . . FIRST to offer multiple nozzle sizes within one valve . . . FIRST with a line of bar stock safety-relief valves for pressures to 10,000 lbs. . . . FIRST to offer internal heat exchangers . . . FIRST to offer realistic pricing, giving the customer the benefit of manufacturing economies . . . and only Farris can point to proved-in-service performance . . . because Farris is the pioneer manufacturer of safety relief valves with bellows.

FOR ENGINEERS: Catalog 48Ra on the full line of Farris Safety Relief Valves; and Technical Manual 51B—"Principles of Manifold Discharge Piping". Available on request.

"THE FOX AND THE HARE"

Send for this popular entertaining pamphlet presenting a story about the recognition of BALANSEAL valves. It is humorous and enlightening. Just ask for it by name.

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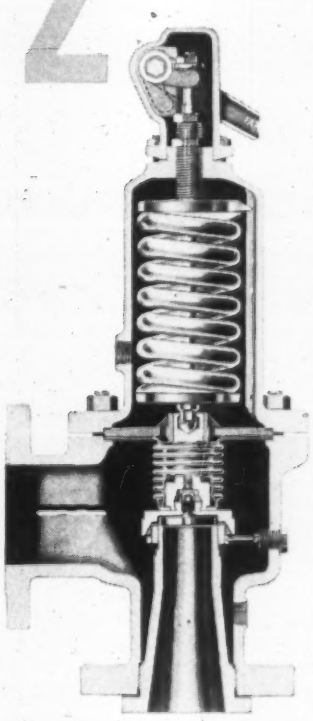
# of ACTUAL SERVICE

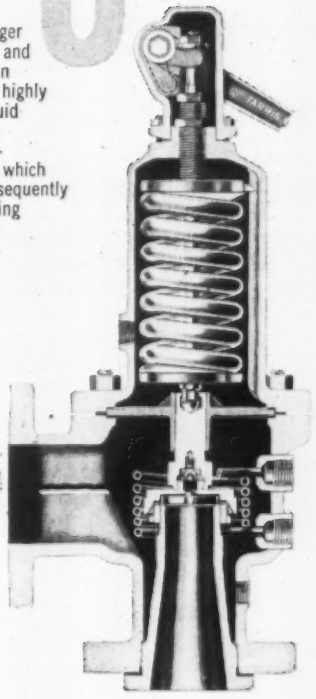
2



INTERNAL HEAT EXCHANGER

The exclusive Farris Internal Heat Exchanger eliminates inefficient and costly steam tracing in a valve body to keep highly viscous media in a fluid state. It consists of a stainless steel coil inserted in the body to which steam is fed and subsequently trapped out. For placing heat where it is most effective, increasing efficiency, lowering steam consumption, the Farris Internal Heat Exchanger is the only available product of its kind.

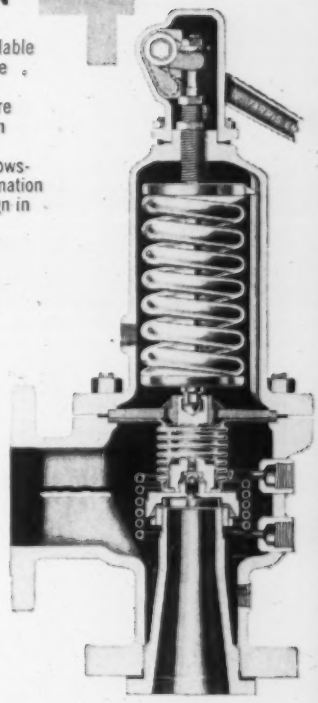
3



BELLOWS—HEAT EXCHANGER COMBINATION

For completely dependable valve operation in spite of sticky fluids (tars, asphalt, etc.) and where complete freedom from contamination is required, select the Bellows-Heat Exchanger combination . . . The ultimate design in safety relief valves for applications where material is highly viscous. All parts are Farris Standard construction.

4



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Coming Soon!

An added line of ultimate capacity nozzle valves

Farris **ENGINEERING CORPORATION**

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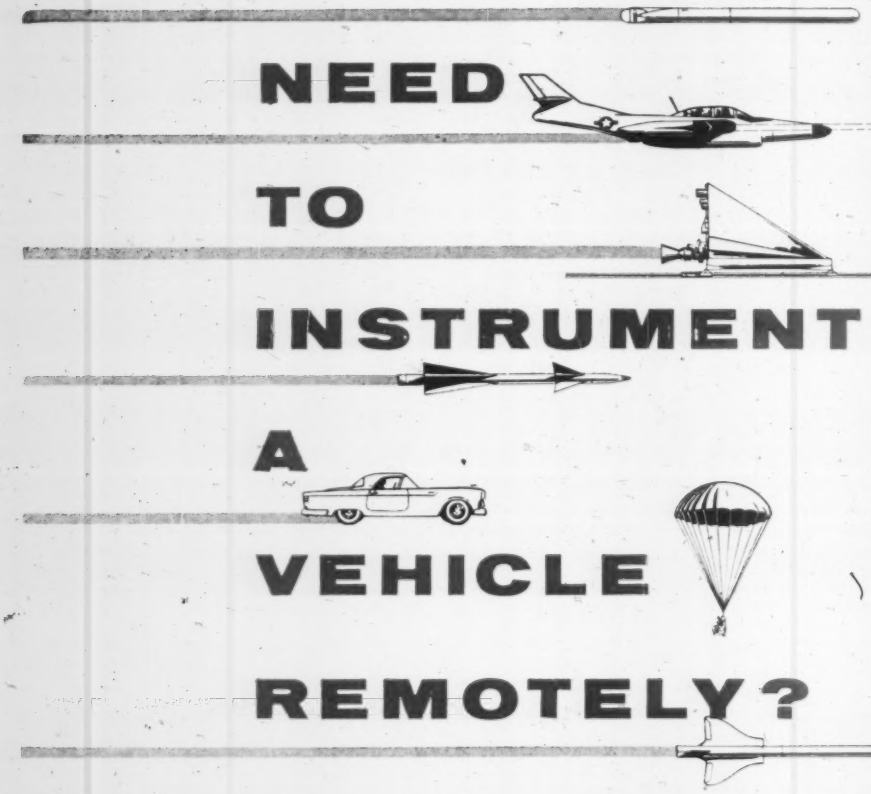
Affiliates: Farris Flexible Valve Corp. • Farris Stacon Corp. • Farris HydroTorque Corp. Farris HydroSeal Corp. • Farris Pickering Governor Co.

For more information circle **24** on inquiry card.



NEED TO INSTRUMENT A VEHICLE REMOTELY?

BENDIX-PACIFIC TELEMETERING SYSTEMS CAN DO IT!

Wherever time, space or weight is a vital factor in successful instrumentation, Bendix-Pacific Telemetering Systems can solve your problem.

These miniature systems, installed in any type of vehicle, will accurately and reliably measure and transmit to a conveniently located receiving station any desired information. Strain, temperature, vibration, position, motion and acceleration are among the characteristics that can be measured.

Bendix-Pacific Telemetered Instrumentation provides you with six distinct advantages over conventional methods.

1. *The information is instantly transmitted to a conveniently located receiving station where technicians can study and direct the procedures while the test is in progress.*
2. *It provides a permanent instrumentation record even though the test vehicle is destroyed or not recovered.*
3. *It relieves vehicle operators from any attention to instrumentation.*
4. *It provides an important safety factor by warning of the approach of dangerous conditions.*
5. *The light weight and flexibility of the vehicular equipment permits even scale model testing.*
6. *It can save you money in both operating costs and equipment investment.*

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THE NAME Bendix AVIATION CORPORATION MEANS MORE

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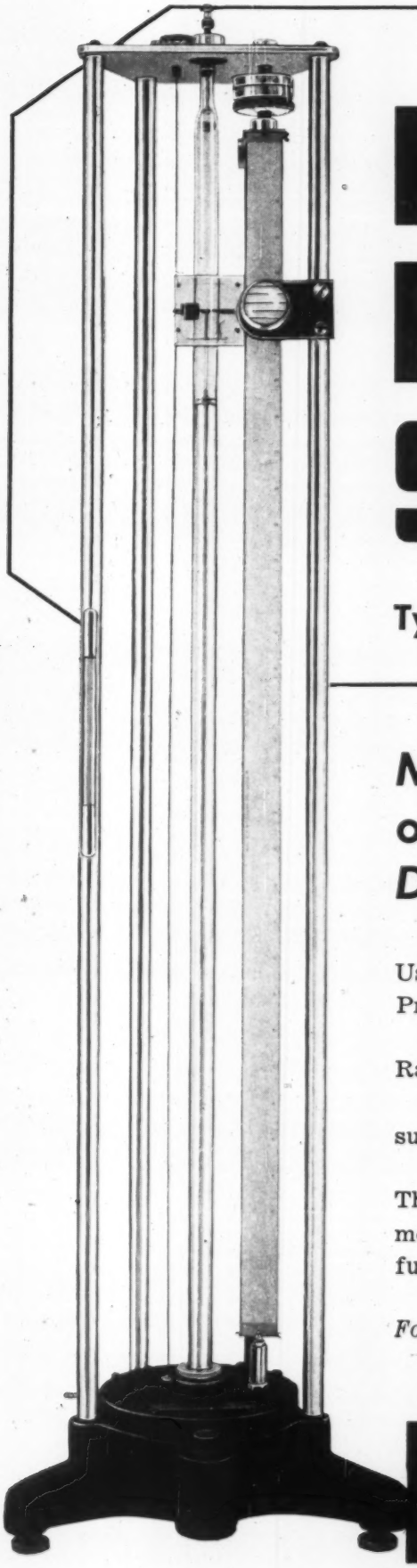

MERCURIAL-PRECISION STANDARD

Type FA-187

Measures *Absolute* or *Differential Pressure*

Used interchangeably as a Barometer or Differential Pressure Manometer.

Range: 0 to 800 mm of Hg.
0 to 31.5 in Hg. or in any other desired pressure unit of equivalent range.

The magnetic vernier reads to 0.01 mm or 0.005 in. of mercury with an accuracy of 1 part in 5000 over the full range.

For additional information,
write for Publication Number TP-32-A.

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A-103

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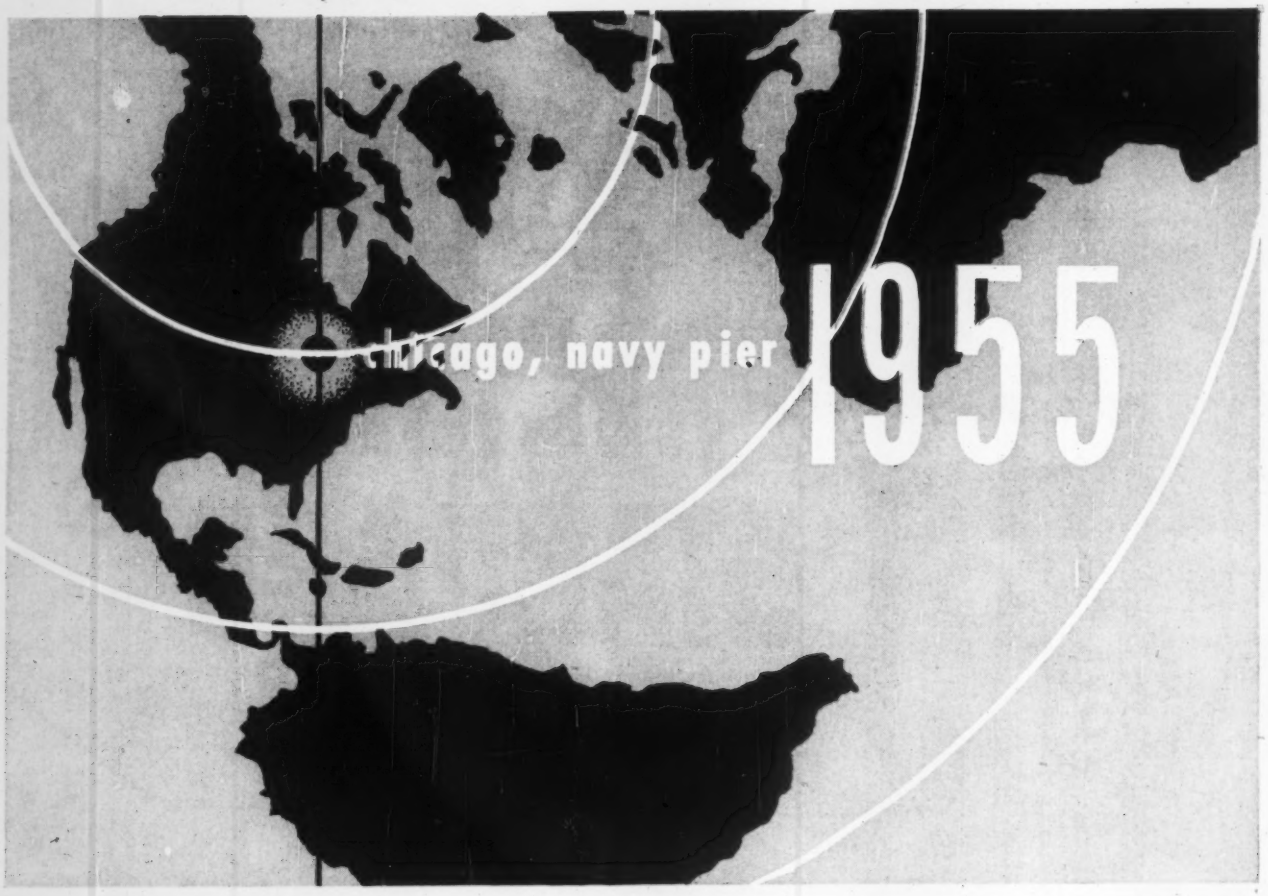

THE FOLLOWING PRODUCTS
Can be Displayed to Advantage

Analog-to-digital converters, Analytical control equipment, Automatic control valves, Automatic control systems, Automatic feeding devices, Automatic gaging equipment, Automatic handling equipment, Automatic inspection devices, Automatic loaders, Automatic machine controls, Automatic tape controls, Beta ray thickness gages, Brakes, clutches and drive mechanisms, Central control systems, Color process controls, Communication systems including closed circuit television, telephone and paging systems, Compressors for automation air, Computers, analog or digital, Computer components, Continuous gas analyzers, Continuous testers, Conveyors, Counters, Data processing and data reduction systems, Data transmission and computations systems, Decade counters, Door operators, automatic, Dust and atmosphere controls, Electric motors, Electronic computers, Electronic control devices, Electronic, electrical and mechanical Components for automatic production systems, Gages air, Governors, Hydraulic cylinders and motors, Indexing machines, Industrial television, closed circuit, Infrared absorption analyzers, Instrumentation and automation panels and cubicles, Instruments for measurement and control, Level controllers, Limit switches, Mass spectrometers, Metering equipment, Monitoring systems, Monorails, Motor controls, Optical gages and inspection devices, Packaged servo controls, Photoelectric control devices, Pneumatic tubes, Positioning equipment, Power supplies, Printed code readers, Radioactivity equipment, Recording equipment, Remote control systems, Scales, Scanning systems, Servo-components, Servomechanisms, Signalling equipment, Speed controls, Strain measuring devices for automatic control, Switches, relays and other electrical components, Teleprinters and facsimile recorders, Two-way radio, Ultraviolet absorption analyzers, Vibration control equipment, Weighing and proportioning equipment, Work positioning mechanisms, X-ray and fluoroscopic devices and X-ray gages.

For more information to help in planning your exhibit write to: The Second

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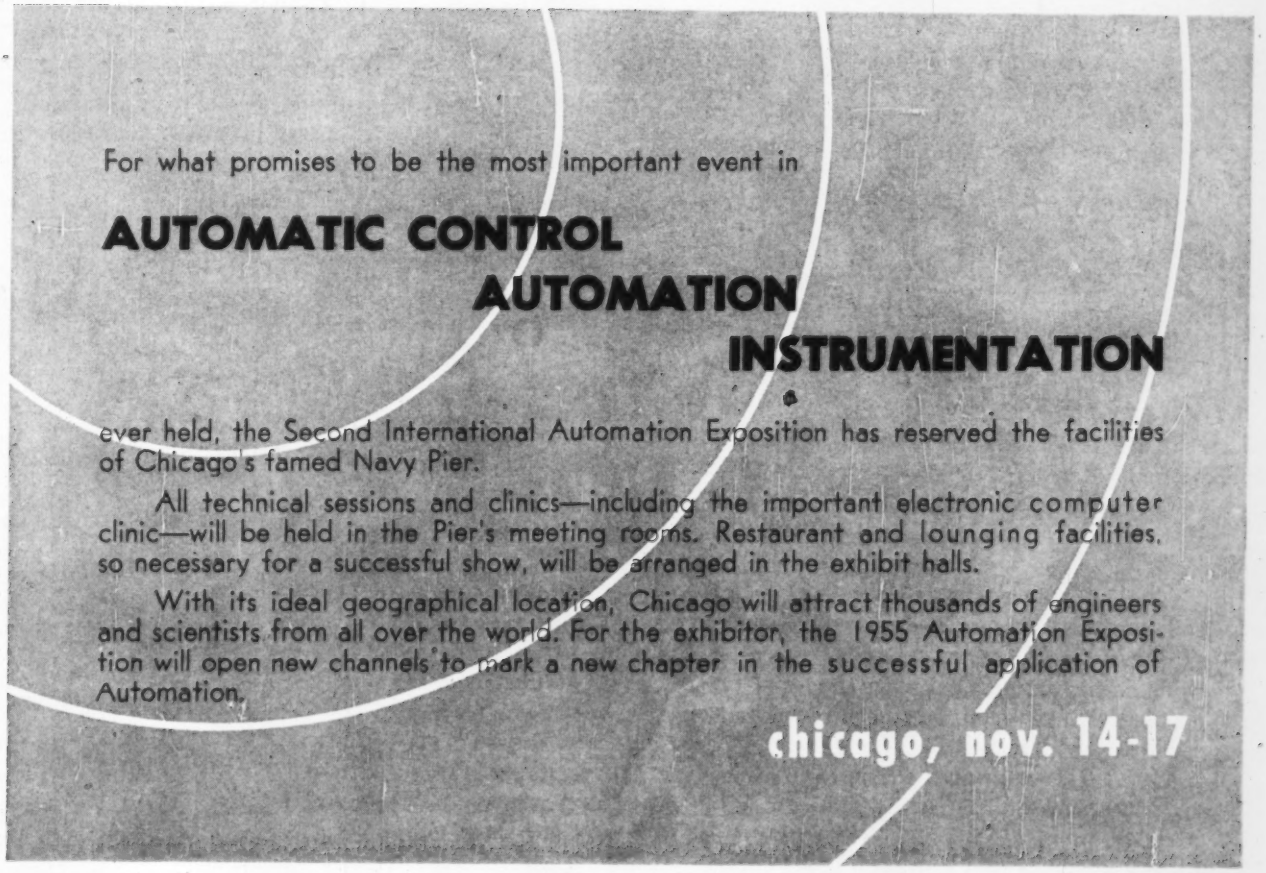
the second international AUTOMATION exposition


For what promises to be the most important event in
AUTOMATIC CONTROL
AUTOMATION
INSTRUMENTATION
ever held, the Second International Automation Exposition has reserved the facilities of Chicago's famed Navy Pier.
All technical sessions and clinics—including the important electronic computer clinic—will be held in the Pier's meeting rooms. Restaurant and lounging facilities, so necessary for a successful show, will be arranged in the exhibit halls.
With its ideal geographical location, Chicago will attract thousands of engineers and scientists from all over the world. For the exhibitor, the 1955 Automation Exposition will open new channels to mark a new chapter in the successful application of Automation.
chicago, nov. 14-17

International Automation Exposition, 845 Ridge Avenue, Pittsburgh 12, Pennsylvania

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NEW ATOMIC CANNON

Added Evidence that—

Everyone Can Count on VEEDER-ROOT

This mobile 280 mm. atomic cannon has *two* recoil motions. The primary recoil absorbs the cannon's "kick". The secondary recoil (something new in artillery) absorbs the forces created by the primary recoil. And each recoil motion is recorded by this special Veeder-Root Counter designed with a plunger-action shaft . . . which keeps the score on the cannon's use and indicates approaching need for maintenance.

This again points up the fact that "Anything Worth Making — or Worth Doing — *Is Worth Counting*." And Veeder-Root has the experience and resources *you* can count on, to give you any counter you need . . . for any mechanical or electrical application . . . in any field from Atomics to Automation. Write:

VEEDER-ROOT INCORPORATED
HARTFORD 2, CONNECTICUT

Chicago 6, Ill. • New York 19, N. Y. • Greenville, S. C.
Montreal 2, Canada • Dundee, Scotland
Offices and Agents in Principal Cities

"The Name that Counts"

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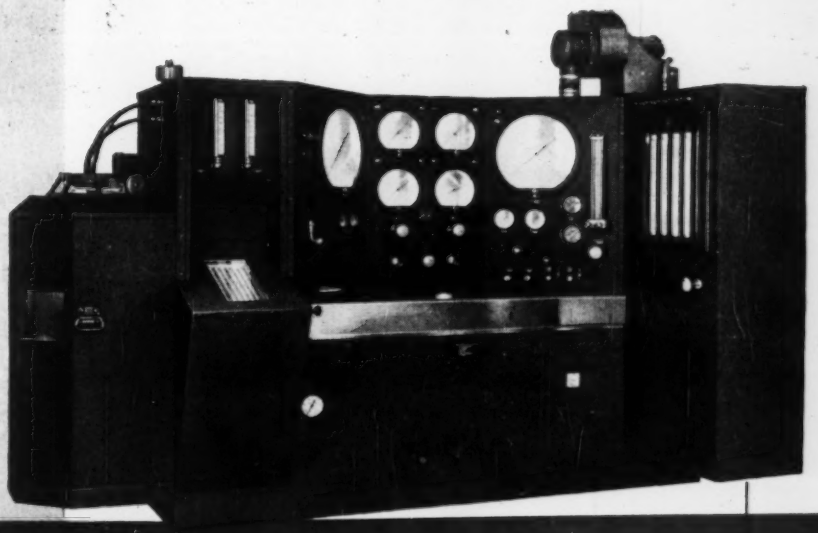
COX TEST STANDS

STAND THE TEST OF TIME!



TYPE 416 UNIVERSAL FUEL NOZZLE TEST STAND

Used by the aircraft industry to test for optimum efficiency of jet fuel nozzles, this highly accurate Cox Test Stand is a "complete modern hydraulics laboratory." Pressure, temperature, and flow rate can be controlled during testing to simulate the actual conditions under which jet fuel nozzles normally operate in the engine.

THE 309 FLOWMETER CALIBRATING STAND

More precision flowmeters are calibrated and checked on Cox Calibrating Stands of which the Type 309 is the latest, than on any other stand used by the automotive and aircraft industries. A precision-weighing mechanism weighs the flow through the flowmeter being tested, assuring precise calibration of the instrument. Portable Cox Calibrating Stands will accommodate single or multiple stage flowmeters of any make.

Other CRL *Products*

- **Single and Multiple Stage Flowmeters**
- **Engine Indicators**
- **Magnetic Thickness Gages**
- **Balanced Electronic Equipment for Measuring Pressure and Vibrations**
- **Vibration Study and Recording Equipment**

• When automotive and aircraft manufacturers first encountered the problem of determining in advance how certain engine accessories would perform under actual operating conditions, Commercial Research Laboratories engineers developed special test stands which would supply this information.

To test for optimum efficiency of jet fuel nozzles, for example, the nozzle is mounted in a Cox Nozzle Test Stand in which temperature and pressure are controlled and fuel is passed through the nozzle at the rate required. The fuel is automatically weighed by an electronic weighing device within the test stand and from this information the nozzle rate of flow is computed.

Cox precision-weighing Calibrating Stands are equally indispensable to automotive carburetor testing since the flowmeters which are used to measure the exact flow rate must themselves be calibrated and regularly checked on these portable, highly accurate stands.

Despite the difficult tasks these and other Cox test stands are called upon to perform in helping industry to solve complex testing problems, they have built up an outstanding record of many years of dependable service and performance.

Write us for descriptive literature and complete details on these and other Cox Test Stands — including Air Flowmeters and Carburetor Flow Stands.

Commercial Research Laboratories, Inc.

20 BARTLETT AVENUE • DETROIT 3, MICHIGAN

Makers of REGISTERED TRADE MARK ***Since 1912***

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You can depend on "Varec" Equipment for Liquid Storage Tanks

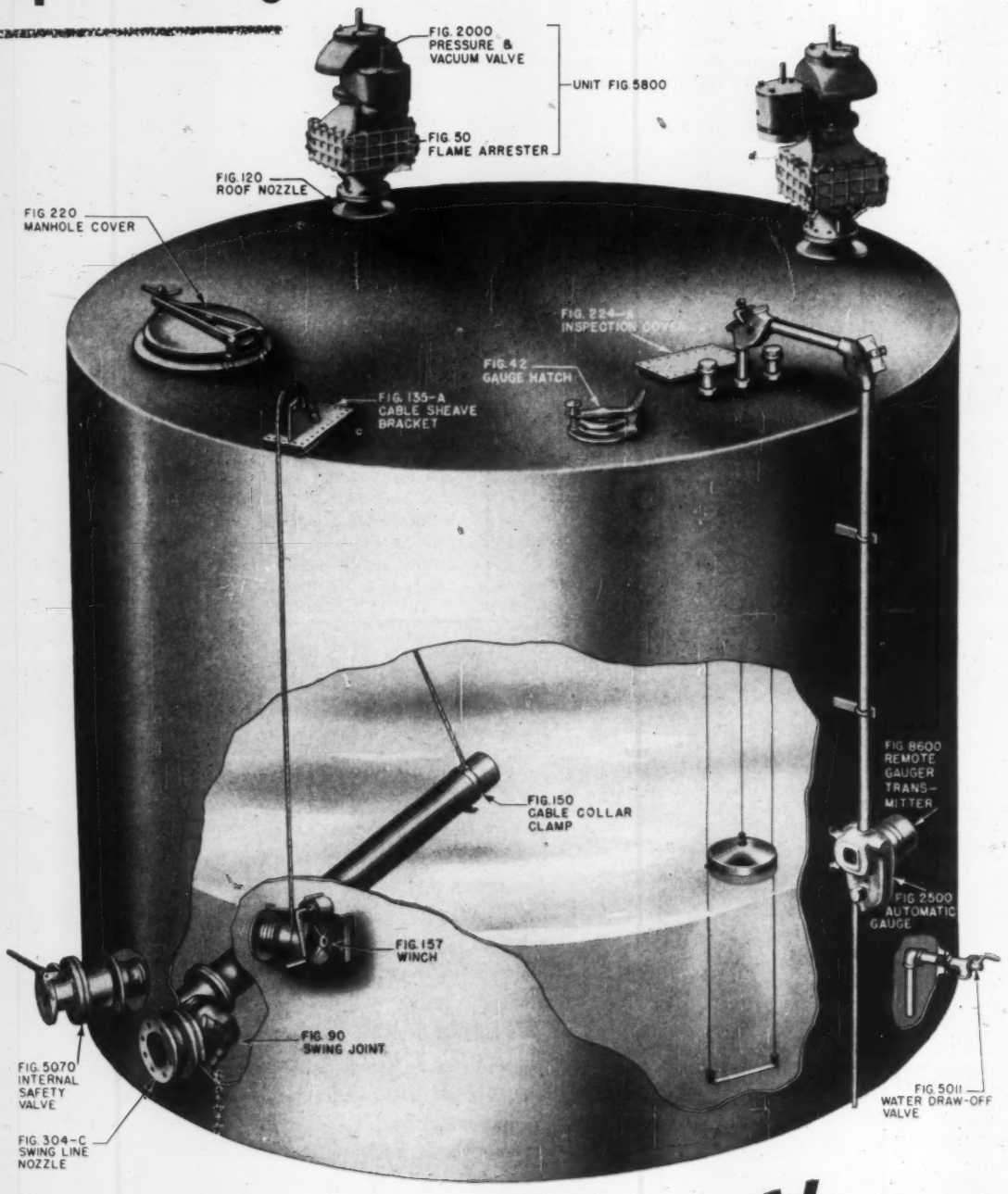
FIG. 2000 PRESSURE & VACUUM VALVE
UNIT FIG. 5800
FIG. 50 FLAME ARRESTER
FIG. 120 ROOF NOZZLE
FIG. 220 MANHOLE COVER
FIG. 224-A INSPECTION COVER
FIG. 42 GAUGE HATCH
FIG. 135-A CABLE SHEAVE BRACKET
FIG. 8600 REMOTE GAUGER TRANS-MITTER
FIG. 150 CABLE COLLAR CLAMP
FIG. 2500 AUTOMATIC GAUGE
FIG. 157 WINCH
FIG. 90 SWING JOINT
FIG. 5070 INTERNAL SAFETY VALVE
FIG. 5011 WATER DRAW-OFF VALVE
FIG. 304-C SWING LINE NOZZLE

For over a quarter of a century, "Varec" has been manufacturing quality tank equipment. Its reliability and satisfaction are attested by thousands of installations located all over the world. Your request for detailed information will bring our prompt reply.

"Varec"

961-4

VAPOR RECOVERY SYSTEMS COMPANY
2820 No. Alameda St., Compton, Calif.
CABLE ADDRESS
Varec Compton, Calif. (U.S.A.) All Codes

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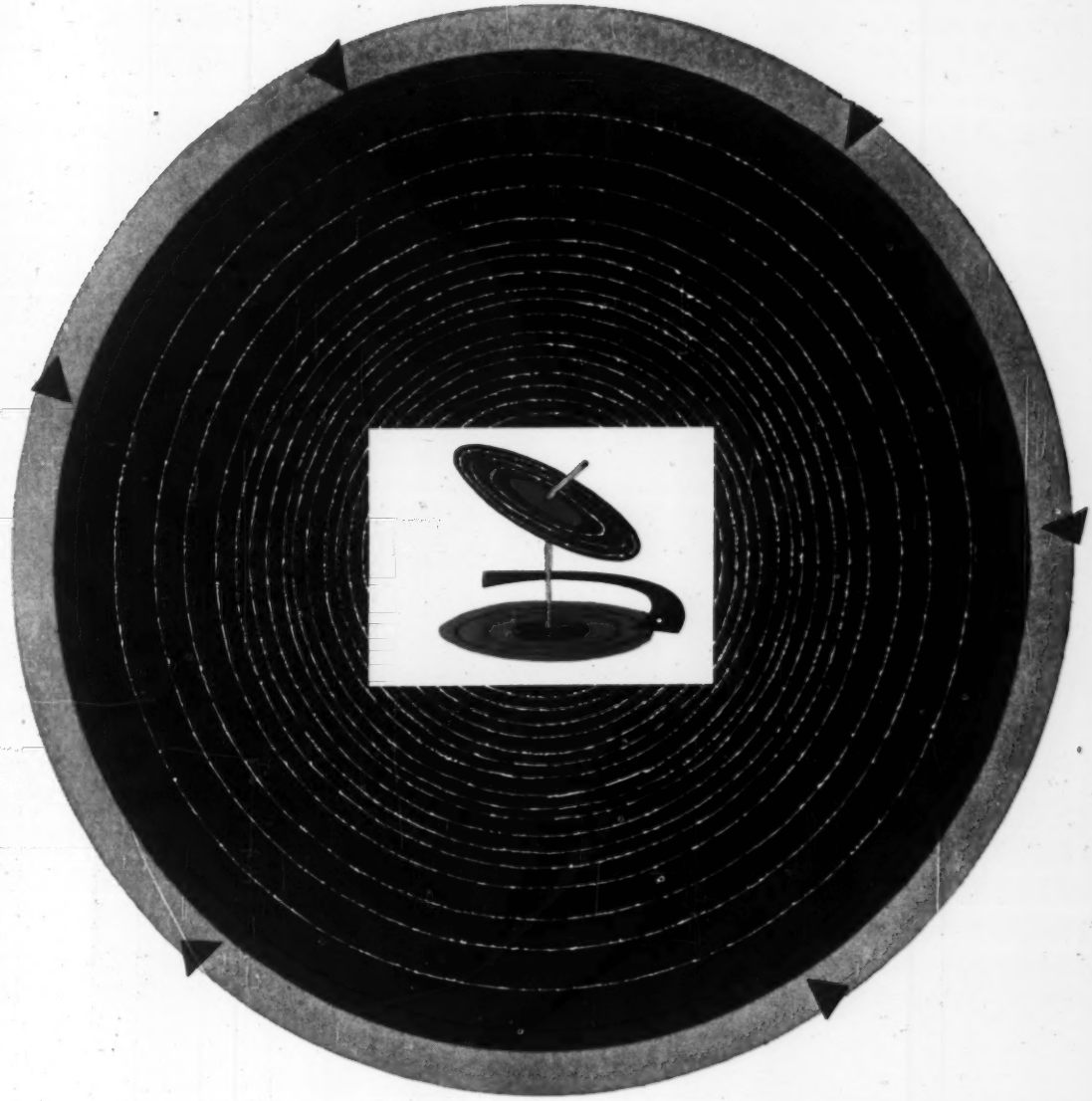


leading Hi-Fi producers specify **CRUCIBLE PERMANENT MAGNETS**

for maximum energy...minimum size

Crucible alnico permanent magnets are unsurpassed in their magnetic properties. They provide *consistently higher* energy product . . . which results in smaller, more powerful magnets.

That's why not only leading producers of high fidelity sound equipment, but hundreds of other discriminating manufacturers of instruments, controls, motors and other magnet-equipped devices, prefer Crucible alnico permanent magnets.

Crucible has been one of the largest producers of this type of magnet since the alnico alloys were first developed. And backing up this twenty-year magnet experience are 54 years of *quality* steelmaking. For highest quality alnico magnets and technical help in their application, *call Crucible.*

CRUCIBLE first name in special purpose steels

54 years of Fine steelmaking

ALNICO PERMANENT MAGNETS

CRUCIBLE STEEL COMPANY OF AMERICA, GENERAL SALES OFFICES, OLIVER BUILDING, PITTSBURGH, PA.

For more information circle **31** on inquiry card.

see for yourself
why ordinary aluminum optical coatings can't compare with the new Miraloy
make this simple test:
1 Compare surface hardness of a Miraloy mirror—an exclusive Houston Technical Laboratories product—with that of an ordinary aluminum coated mirror by drawing a pencil point or other sharp object firmly across the surface of each mirror.
2 Coated side down, hold each mirror directly over the flame of a match.
3 Rub both mirrors with a linen handkerchief or other rough fabric.
4 Now — using a magnifying glass — examine the surfaces of both mirrors and see the difference. After undergoing the abuse described above, the extra-hard Miraloy surface — which compares favorably in hardness to Rhodium coatings — will win by a wide margin over ordinary aluminum coatings.

Miraloy is the new optical coating developed by Houston Technical Laboratories to provide a hard, corrosion and heat resistant coating for first surface mirrors. Exhaustive comparison by all known hardness, abrasion and corrosion tests have proved it far superior to all other standard coatings. And, in all ranges of the spectrum, its reflectivity is equivalent to pure aluminum. **Yet Miraloy costs no more than ordinary aluminum coatings.**

write for sample to make this test! At your request, we shall be glad to supply you with a sample mirror that has been coated with *Miraloy*. You are urged to subject it to the rigorous test described above. We also invite your inquiries about other HTL optical components. HTL precision lenses and mirrors can be made to your specifications.

HTL

HOUSTON TECHNICAL LABORATORIES

A SUBSIDIARY OF TEXAS INSTRUMENTS INCORPORATED

2424 BRANARD • HOUSTON 6, TEXAS, U.S.A. • CABLE: HOULAB

For more information circle **32** on inquiry card.

OHMITE "Brown Devil"

RESISTORS have BALANCED THERMAL EXPANSION!

High-quality resistors for your *tough* jobs!

When you want a resistor that will stand up under high temperatures, specify Ohmite Brown Devils. They have been carefully designed to provide "balanced thermal expansion." All parts—core, resistance wire, vitreous enamel coating, and terminal band—have a thermal expansion that has been carefully matched. As a consequence, "Brown Devil" resistors expand and contract as a unit. This eliminates cracking of the enamel, keeps terminals firmly anchored, and prevents the entrance of moisture.

For many years, these superior Ohmite resistors have proved their reliability under the toughest service. Specify them on your next job.

1 PATENTED WELDED TERMINALS

Ohmite welded terminals provide a perfect and permanently stable electrical connection that is unaffected by vibration or high temperature.

2 HIGH TEMPERATURE STEATITE CORE

This strong, rugged steatite core has excellent electrical characteristics, and a coefficient of thermal expansion that matches the other resistor materials.

3 EXCLUSIVE HIGH TEMPERATURE VITREOUS ENAMEL

This special-formula enamel was developed by Ohmite after extensive research. Its thermal expansion is properly related to that of the steatite core, terminal, and resistance wire.

NEED RELAYS?
Write for Catalog R-10
American Relay & Controls, Inc.
3615 Howard St., Skokie, Ill.
. . . an OHMITE Subsidiary

OVER 100,000,000 SOLD!

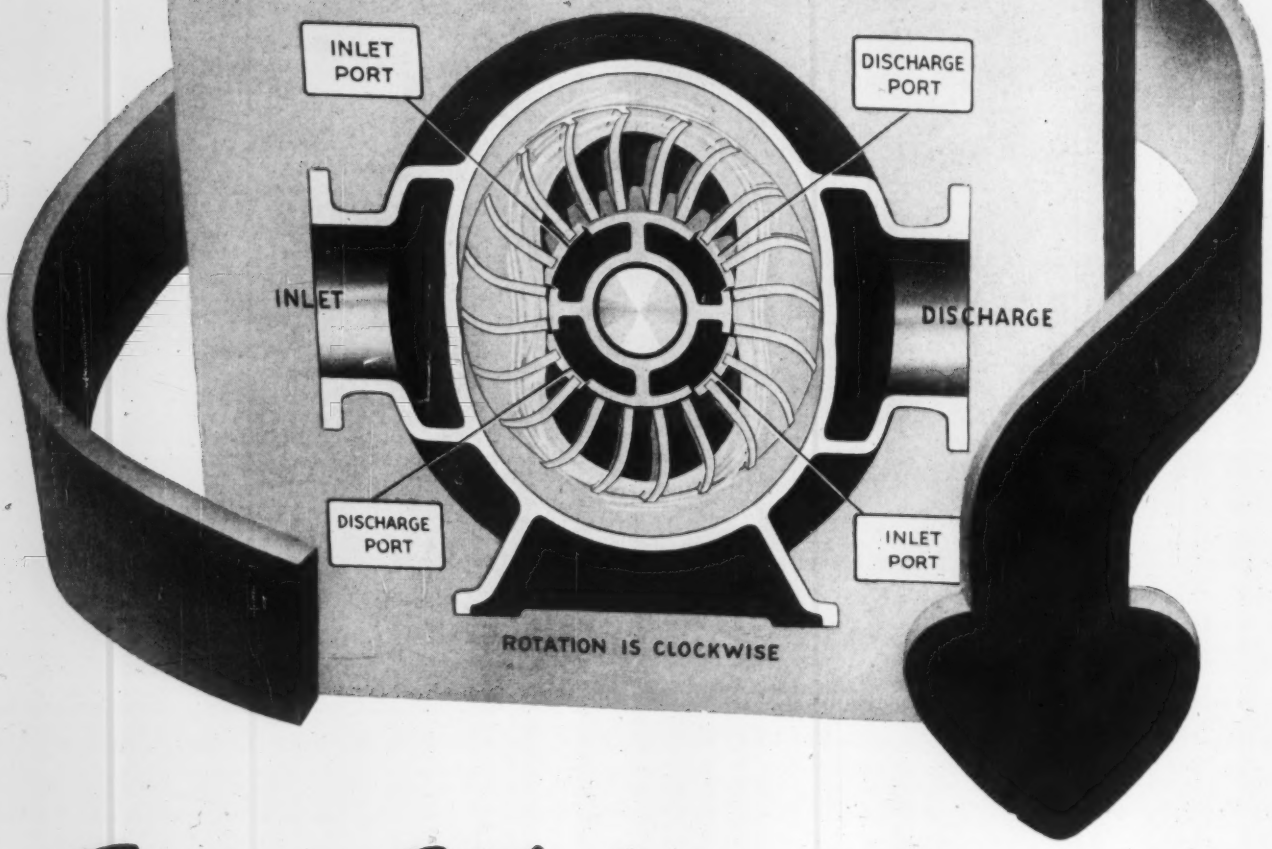
Be Right with OHMITE®

RHEOSTATS
RESISTORS
TAP SWITCHES

OHMITE MANUFACTURING COMPANY, 3615 Howard Street, Skokie, Illinois (Suburb of Chicago)

For more information circle 33 on inquiry card.

Nash Instrument Air Compressors deliver only clean air, free from oil or dust, and without filters



Here is Why!

You can dispense with oil filters and dust filters when you install ®Nash® Clean Air Compressors. You can save the cost of maintaining these devices. You can greatly reduce instrument maintenance costs. For the Nash employs no internal lubrication, therefore no troublesome oil is in the delivered air. Moreover, air from a Nash is thoroughly washed and cooled as it passes thru the pump. Dust in the plant atmosphere, even fly ash, is immediately removed.

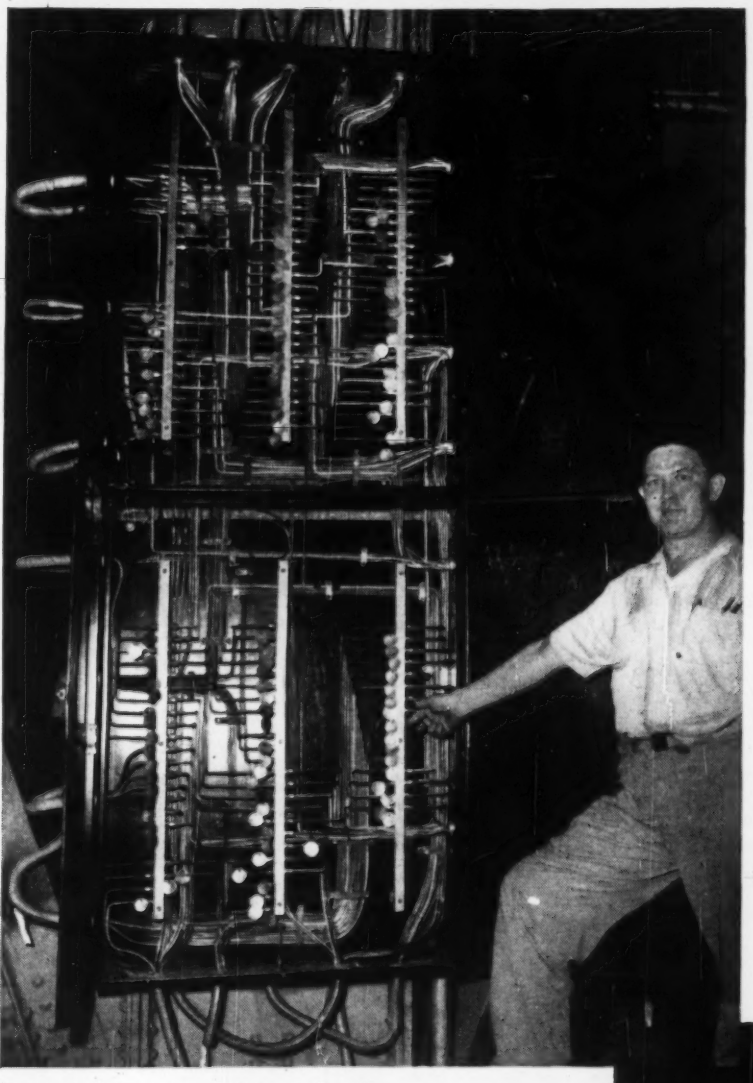
®Nash® Clean Air Compressors are simple, with only one moving element. No valves, gears, pistons, sliding vanes, or other enemies of long life and constant performance complicate a Nash. No aftercoolers are needed. You will find it profitable to investigate these pumps, now.

- No oil filters.
- No dust filters.
- No internal lubrication to contaminate air handled.
- No internal wearing parts.
- No valves, pistons, or vanes.
- Non-pulsating pressure.
- Original performance constant over a long pump life.
- Low maintenance cost.

NASH ENGINEERING COMPANY
370 WILSON, SO. NORWALK, CONN.

FOR INSTRUMENTATION AND CONTROL

Cabled Tube



Control Junction Box at Power Station of Long Island Lighting Company, showing use of Crescent Armored Multitube. Note that relatively sharp bends can be made without damage to the cabled copper tube.

Some time ago Revere ran an advertisement featuring Crescent Armored Multitube for use in pneumatic and hydraulic instrumentation and control systems. The advertisement created so much interest that we thought you might like to see a photograph of an actual installation. The Control Board Junction Box shown here has 22 runs of Multitube coming into this box comprising 224 Revere Copper Tubes of 1/4" O.D. The picture was taken in the Glenwood Landing, N.Y. Power Station of the Long Island Lighting Company. The tubes go to instruments that report information on temperature, main and reheat steam pressure, boiler feed and condensate pump pressure, fuel oil and gas pressure, liquid levels, tide level and for the control of fuel feed, draft dampers, boiler drum water level and various control valves.

This is a relatively new use for Revere Copper Tube, but it is an important one in these days when new ways are being found to obtain process information more quickly and accurately, or to achieve automatic control. Crescent Armored Multitube is made by Crescent Insulated Wire & Cable Co., Inc., Trenton 5, N.J., in lengths up to 1,000 feet. It consists of a group of long tubes twisted together in cable form, protected by a flexible interlocked galvanized steel armor, or by plastic, or both. As many as 19 tubes, 1/4" O.D., can be cabled, with one tube in each layer color-coded. Larger tubes can also be cabled, including 5/16", 3/8" and 1/2". This construction affords protection during shipment, installation and use, and speeds up installation greatly. For further information, write Crescent, and for tube in copper and aluminum, see the nearest Revere Sales Office.

REVERE

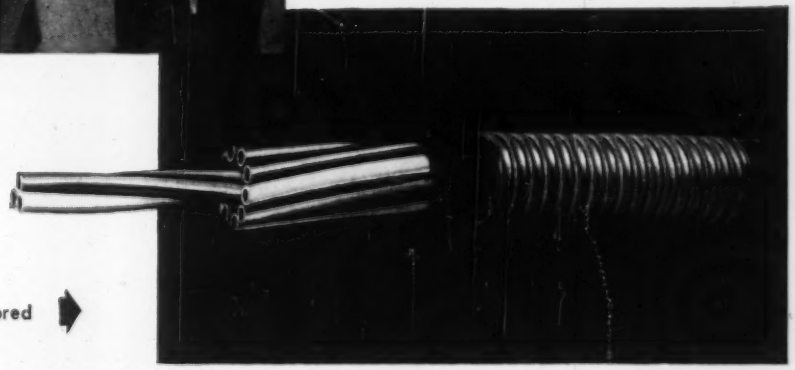
COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

• • •

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y. Sales Offices in Principal Cities, Distributors Everywhere.



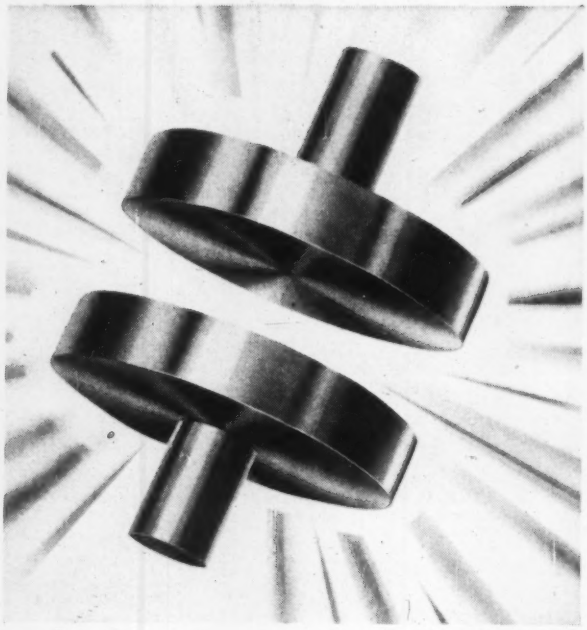
Construction of Crescent Armored Multitube.

For more information circle **34** on inquiry card.

Are the contacts you use

GOOD ENOUGH...

or TOO GOOD ?



The answer to this question can make an important difference in the performance and cost of your product. If your contacts do not measure up to their intended job, they can seriously detract from the satisfactory operation, freedom from maintenance, and acceptance of the equipment in which they are used. If the contacts are too good, or over-designed, they add uselessly to the cost of the finished equipment.

Designing a contact for a specific job, however, is a real engineering problem. It involves consideration of many electrical, mechanical and environmental factors. The current and voltage in the interrupted circuit . . . the type of load . . . the expected service life . . . contact gap . . . contact pressure . . . ambient temperature and atmosphere . . . these and many other aspects of the problem demand evaluation.

From Mallory, you can be *sure* of getting contacts that will perform correctly in your application . . . at a price that fits your production budget.

THE RIGHT MATERIALS. The extensive selection of contact materials developed by Mallory's metallurgical research includes an unequalled variety of specialized materials.

THE RIGHT DESIGN. Mallory engineers apply to your problem the knowledge gained in thirty years of contact experience. Standard designs are recommended wherever possible for standard requirements . . . and for special needs, custom-fitted designs are developed.

THE RIGHT PRICE. Mallory cost-saving design assures top economy consistent with service requirements. Further economies are often realized by having Mallory fabricate your complete contact assemblies for you.

A Mallory engineer will be glad to discuss your particular problem. Write or call today for a consultation, and for a copy of the Mallory Contact Catalog.

Expect more...
Get more from P.R. MALLORY & CO. Inc. MALLORY

In Canada made and sold by Johnson Matthey & Mallory, Ltd., 110 Industry Street, Toronto 15, Ontario

Serving Industry with These Products:
Electromechanical—Resistors • Switches • Television Tuners • Vibrators
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P.R. MALLORY & CO. Inc.
MALLORY
P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

For more information circle **35** on inquiry card.

V5 Series
ACTUAL SIZE

UNIVERSALLY USED*

Compact Low-Cost SKINNER Solenoid Valve For Thousands of General Service Applications

No other valve can match the utility and economy offered by the Skinner V5 (Universal) Valve. It is Underwriter approved for all-purpose service, and is suitable for all common media. Its applications are virtually unlimited, and include use on aircraft, automotive, chemical, dental, refrigeration, drink dispensing, heating, industrial, pilot and process control, and instrumentation equipment.

Valves of this series give fast dependable operation — *through* millions of cycles. They are direct acting, spring loaded, *leakproof* . . . and perform perfectly in any position, in ambient temperatures from minus 250°F. to plus 450°F. Available in a broad selection of types, electrical outlets, port locations and sizes, flow adjustments and coil types.

Also available with "Quick Exhaust" for extra fast cylinder return.

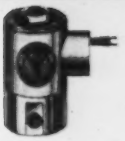
Media — Air, gasoline, inert gases, kerosene, oils, water, steam and many semi-corrosive media.

Pressure Rating — 0-1000 p.s.i.

Construction — Leakproof sealing, bubble-tight shut-off at all ports; packless, frictionless construction; stainless steel internal parts; moisture-resistant, varnish-impregnated coils.

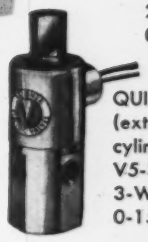
Specifications — *Type* — Two- or three-way, normally open or normally closed, or with directional control.
Duty Cycle — Continuous or intermittent.
Orifice Diameters — 3/64" to 1/4"
Pipe Size — 1/8" or 1/4" NPT.
Voltage — all common AC and DC voltages.
Power Consumption — 10 watts.

Do you have a valve problem? Ask us for the services of a specially trained Skinner resident engineer — he'll tackle your problem immediately.



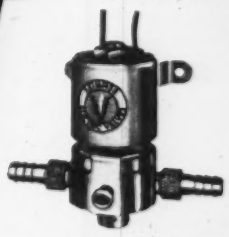
GENERAL SERVICE
& VACUUM
V5 Series
2- & 3-Way
0-1000 p.s.i.

MINIATURE
CUT-OFF
V2 Series
2-Way
0-250 p.s.i.



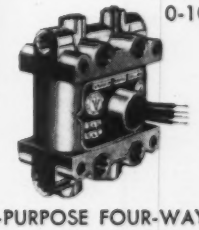
QUICK EXHAUST
(extra fast
cylinder return)
V5-3 Series
3-Way
0-150 p.s.i.

HI-PRESSURE
HYDRAULIC
V10 Series
2- & 3-Way
0-1000 p.s.i.

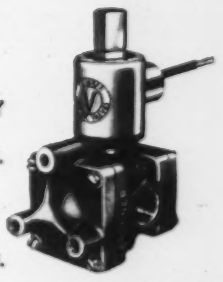


SANITARY
V4 Series
2-Way
0-20 p.s.i.

EXPLOSION-PROOF
X5 Series
2- & 3-Way
0-1000 p.s.i.



ALL-PURPOSE FOUR-WAY
V9 Series
4-Way 0-150 p.s.i.



HI-FLOW INDUSTRIAL
M Series
2- & 3-Way 5-150 p.s.i.

World-Wide Representation — Immediate Delivery on Standard Valves

SKINNER VALVES

SOLENOID

SKINNER ELECTRIC VALVES

SKINNER ELECTRIC VALVE DIV.
The Skinner Chuck Company
116 Edgewood Avenue, New Britain, Connecticut
Please send us your bulletins on the following Skinner valves:

.....

.....

Please have a Skinner representative call on (date)

.....

Name.....
Company.....
Street.....
City.....*Zone*....*State*.....

® THE CREST OF QUALITY

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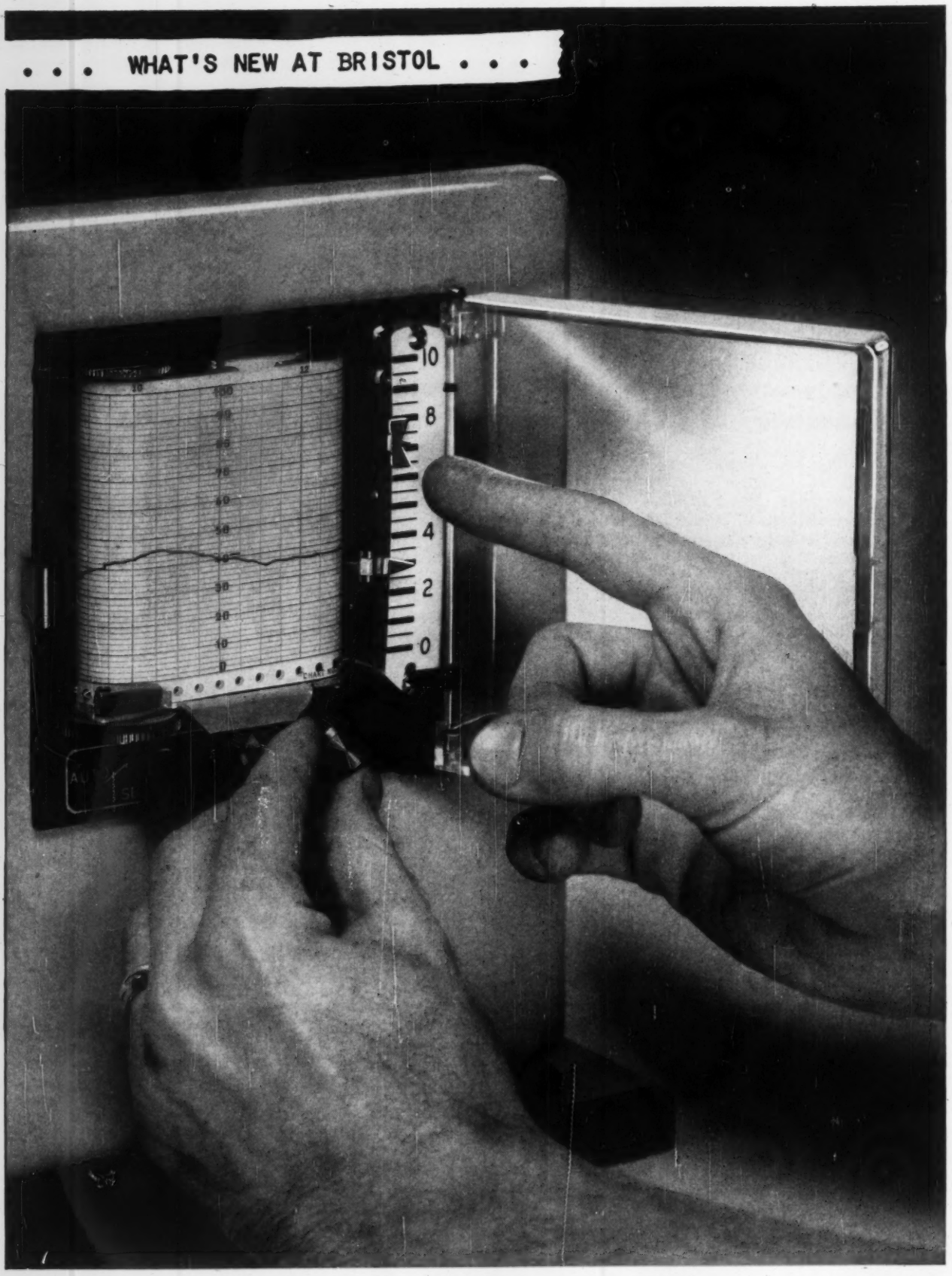


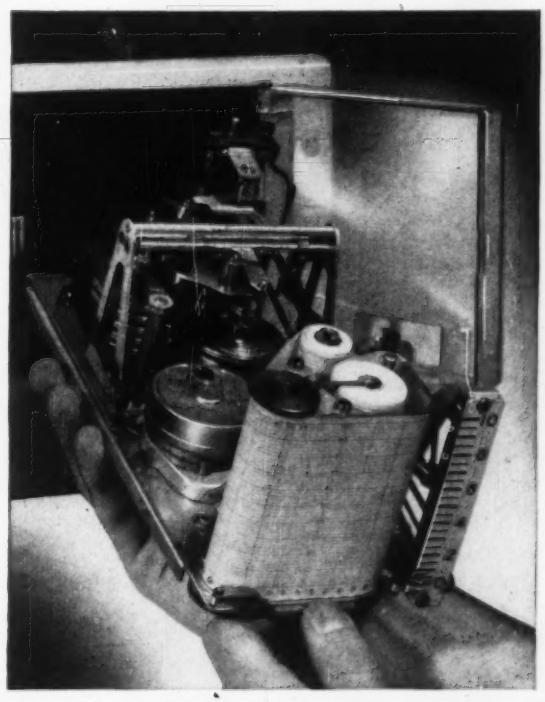
For more information circle 37 on inquiry card.

Instrument men call Bristol's METAGRAPHIC Recorder

"... the biggest little instrument in the industry"

Sounds contradictory, but it's true. Take a look at one of our new METAGRAPHICS mounted on a panel board alongside of other instruments. The Bristol unit stands out – seems bigger than the rest – although chances are it's actually smaller (5" x 5½"). The answer is that the Bristol instruments have been *"human-engineered"*, making them easy to read, and clearly visible at greater distances.

To meet the increasing need for miniature instruments, we didn't simply scale down one of our larger recorders, we designed a completely new unit, creating a smaller instrument with all the advantages of the large one. In other words, the new METAGRAPHIC is a "big" little recorder.



TRUE PLUG-IN SERVICE is a big advantage to the operating man. If trouble is suspected in an instrument, the doubtful unit can be removed and a spare plugged in in a matter of seconds, with no interruption in the process operation, no loss of air, no loss of control.

"Human-engineered" METAGRAPHIC records pressure, temperature, vacuum, flow, differential pressure, and liquid level

Here are some of the advantages of the air-operated Metagraphic Recorders:

SIMPLICITY . . . fewer moving parts, fewer adjustments, and less service required. Range changes can be made in seconds.

CONTINUOUS VALVE-POSITION INDICATION . . . on same instrument scale as set-point scale, gives continuous data on control valve position—makes "bumpless" transfer possible simply by matching pointer positions – no need to read actual scale values – minimizes reading errors – speeds operations.

TRUE PLUG-IN SERVICE . . . provides great savings in installation costs. Cases can be ordered and installed before selecting range and type of control. Instruments can be plugged in later or interchanged at will. This adds up to a big advantage to the process design engineer – he doesn't need to make decisions during the design stage that can't be easily changed later.

CONTINUOUS OPERATION . . . complete unit can be retracted for inking pen, and for set-point and zero adjustment without disturbing record or control.

Get the whole story on the "human-engineered" METAGRAPHICS – how they can help you get more accurate measurements, faster and easier. Write us today. The Bristol Company, 113 Bristol Road, Waterbury 20, Conn.

6.4.3R

BRISTOL

POINTS THE WAY IN HUMAN-ENGINEERED INSTRUMENTATION

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

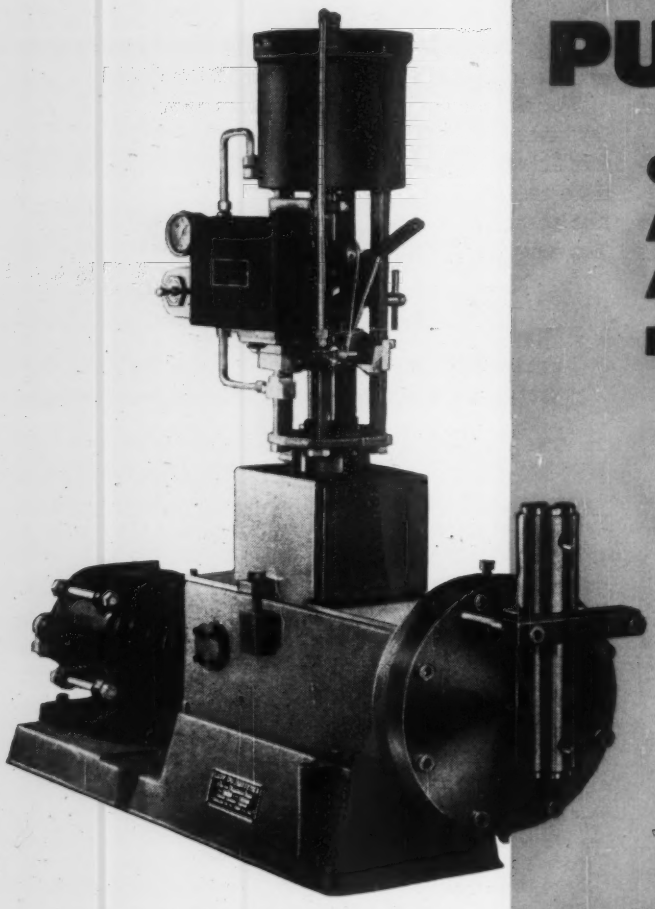
For more information circle **37** on inquiry card.

NOW!

Lapp *Auto-Pneumatic* PULSAFEEDER

OPERATES AT FULL CAPACITY AND FULL RATED PRESSURE

The Lapp Auto-Pneumatic Pulsafeeder has made possible automatic continuous processing in many processes involving chemicals or mixtures which have not been satisfactorily handled by pumps of conventional construction. In this construction, pumping rate is controlled by instrument air pressure responsive to variable flow, pH, temperature, liquid level, pressure, or any other instrument-measurable processing variable. And now, new improved Auto-Pneumatic instrumentation provides for greater capacity and/or pressure—full ratings as listed for manually-controlled models.



TWO PUMPS IN ONE!

Lapp Pulsafeeder is the combination piston-diaphragm pump for controlled-volume pumping of fluids. Reciprocating piston action provides positive displacement. But the piston pumps only an hydraulic medium, working against a diaphragm. A floating, balanced partition, the diaphragm isolates chemical being pumped from working pump parts—eliminates need for stuffing box or running seal. Constant pumping speed; variable flow results from variation in piston-stroke length —controlled by hand-wheel, or, in Auto-Pneumatic models, by instrument air pressure responding to any instrument-measurable processing variable.

WRITE FOR BULLETIN 440 with typical applications, flow charts, description and specifications of models of various capacities and constructions. Inquiry Data Sheet included from which we can make specific engineering recommendation for your processing requirement. Write Lapp Insulator Co., Inc., Process Equipment Div., 378 Wilson St., Le Roy, N.Y.

For more information circle **38** on inquiry card.

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IN GOVERNMENT

IN VOCATIONAL and TECHNICAL SCHOOLS and UNIVERSITIES

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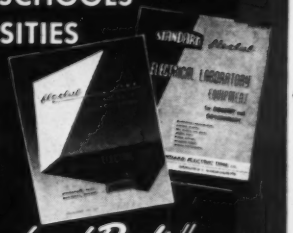

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IN GOVERNMENT

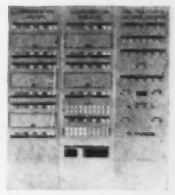
Naval Research Laboratory

Los Alamos Physics Laboratory

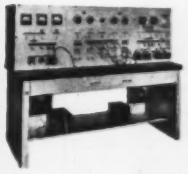
McClellan Air Force Base

Aberdeen Proving Grounds

Naval Air Development Station

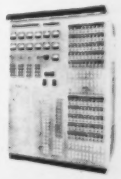


Frankford Arsenal



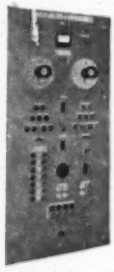
Pensacola Naval Air Station

White Sands Proving Grounds



Naval Research Laboratory

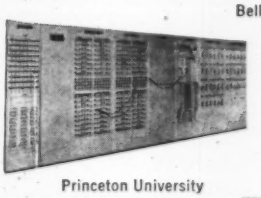
IN SCHOOLS and UNIVERSITIES



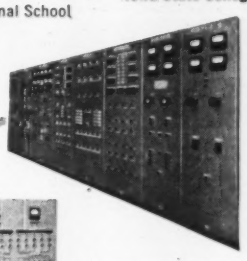
Bell Vocational School

Bell Vocational School

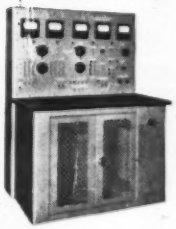
Iowa State College



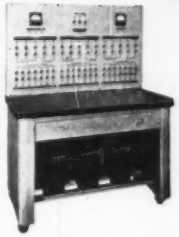
Princeton University



Bergen County Vocational School



Technical School



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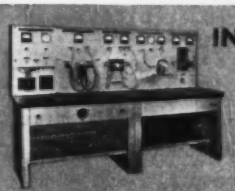
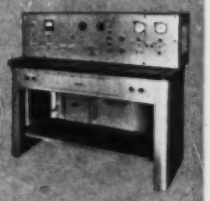
IN INDUSTRY and RESEARCH

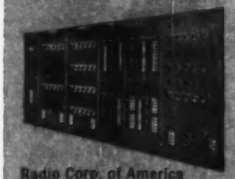


Westinghouse Electric Co.

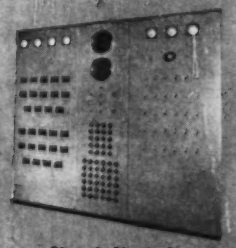
Monsanto Chemical Co.



Ford Motor Co.

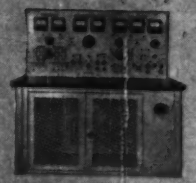


Radio Corp. of America



Glenn L. Martin Co.

Commonwealth Edison



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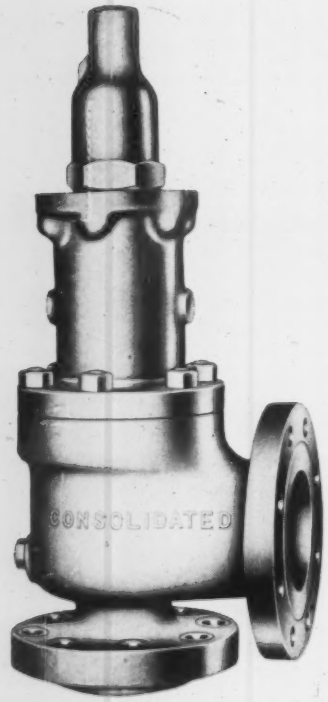
NOW... CONSOLIDATED SAFETY RELIEF VALVES in economical "2 in 1" design

Peak performance . . . positive valve action assured . . . even where discharge lines are long, or low "superimposed" back pressure exists in the relieving system.



"Two-In-One" design, improved performance . . . the new Consolidated Safety Relief Valve is the result of over 4,000 flow tests in 5 years at West Edmond, Oklahoma. At the A.S.M.E.-approved testing station there, natural gas is available in flow capacities up to 35,000 cfm and pressures up to 500 psig. The A.S.M.E.-approved conditions, apparatus, and procedures permitted Consolidated engineers to test-develop and prove the full range of valve sizes and pressures in both Standard and Bellows designs.

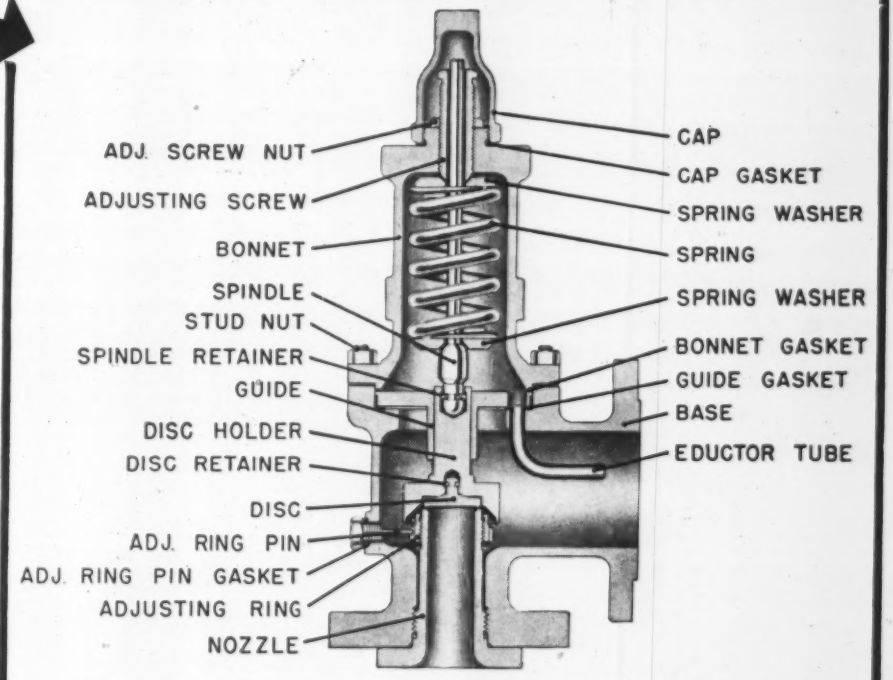
Interchangeability is so highly developed that the majority of Consolidated Standard Valves can be converted to the Bellows design, in the field, simply by installing the bellows. Each type has fewer functional parts than other comparable safety relief valves. Standardization of inlet and outlet center-to-face dimensions permits interchangeability with a large proportion of the valves of other manufacturers. Incorporated is an optically-ground flat seating surface that contributes to easier, more economical maintenance.

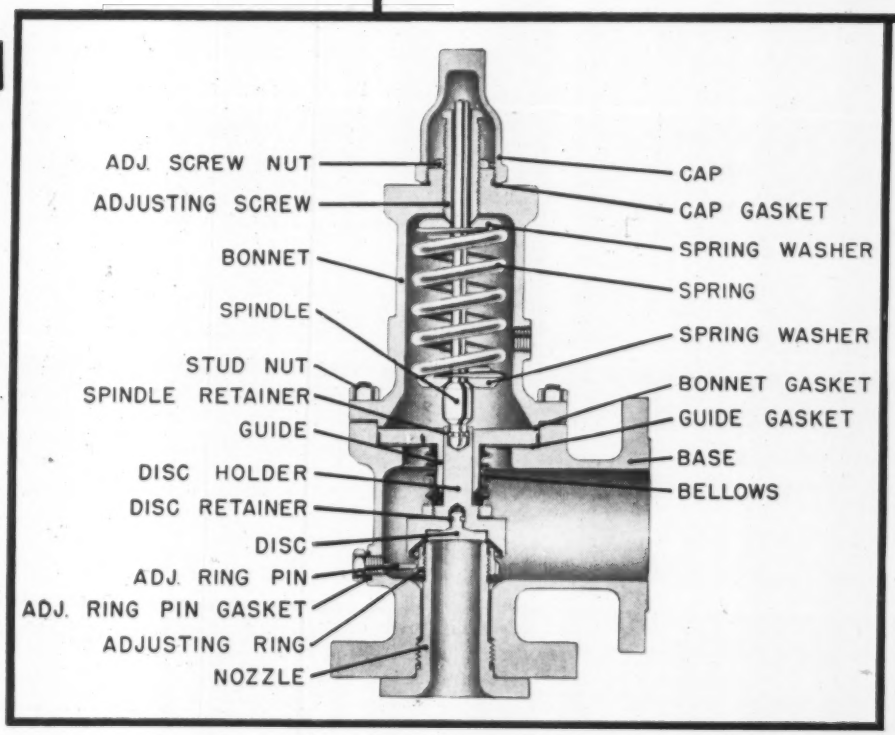
You can have the absolute protection and real economy of the thoroughly tried and proved Consolidated Safety Relief Valves for your plant today. Both Standard and Bellows types are available in sizes and pressures to meet requirements of the most advanced processing facilities. Write for full details. Ask for Catalog 1900.

CONSOLIDATED SAFETY RELIEF VALVES

For more information circle 40 on inquiry card.

STANDARD VALVE has an eductor tube that holds the pressure in the valve bonnet to approximately atmospheric pressure; thus only the force of the spring controls the valve. Valve action is improved and stabilized . . . repetitive flow capacity is provided . . . a new high in operational dependability is assured. Even under repeated popping of the valve, set pressure and blowdown are consistent. The valve will open to full capacity at 3% overpressure regardless of the position of the adjusting ring.





BELLOWS VALVE is like the Standard but has a durable, two-ply stainless steel sealing bellows which effectively isolates from the valve's working parts any contaminants, corrosion, or viscous fluids. The bellows is balanced with the seating surface: set pressure of the valve is not affected by back pressure, whether constant or variable. Consequently, smaller discharge piping can be used, thus reducing the cost of pressure-relieving systems.

Certified and Approved

Both Standard and Bellows Valves are approved under A.P.I.-A.S.M.E. Unfired Pressure Vessel Codes, A.S.M.E. Unfired Pressure Vessel Code and are certified by the National Board of Boiler and Pressure Vessel Inspectors.

1879 CONSOLIDATED U.S.A.

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TULSA, OKLAHOMA

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* AIRCRAFT CONTROL PRODUCTS, *Danbury & Stratford, Conn. and Inglewood, Calif.* "SHAW BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*

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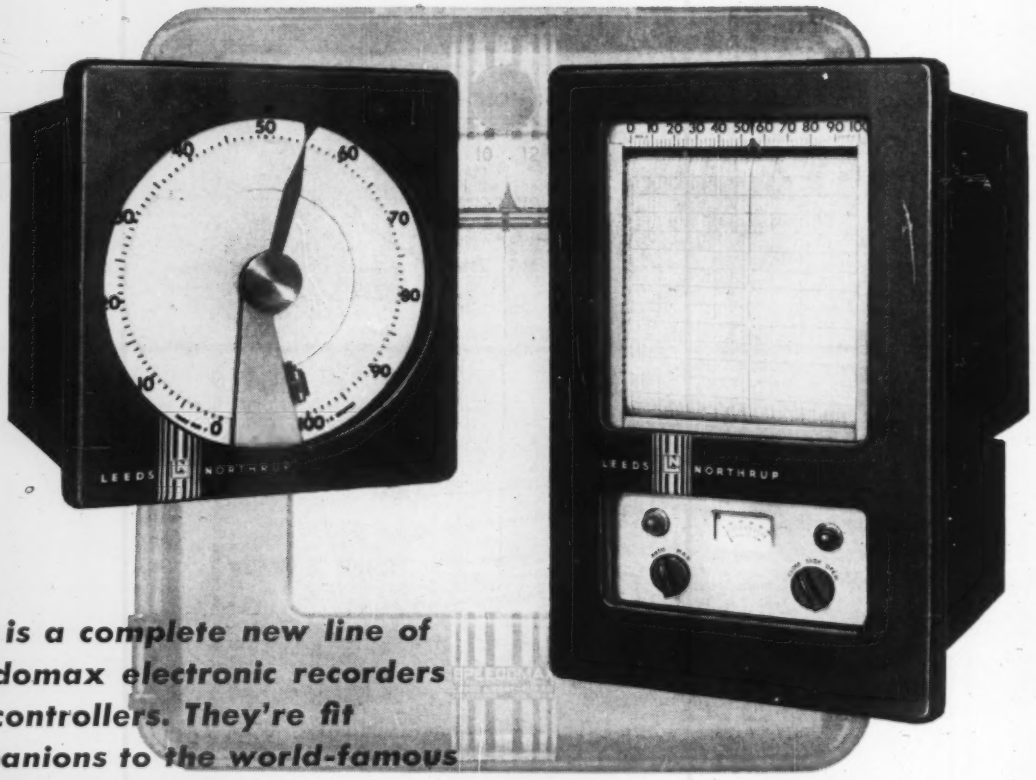
For more information circle **40** on inquiry card.

New, compact

Speedomax® Instruments can modernize process control in hundreds of plants!



Here is a complete new line of Speedomax electronic recorders and controllers. They're fit companions to the world-famous Speedomax Type G. They are called Type H.

These new instruments can help the operation of a tremendous variety of industrial processes—including many which are perhaps now under-instrumented. And L&N's new production techniques bring Speedomax H equipments within reach of processes which couldn't formerly justify high-quality electronic potentiometers.

Especially significant to operators who now employ filled-system and deflection instruments are the benefits of electronic potentiometer performance. For instance, you can install Speedomax wherever you wish, without a thought for the distance to its sensing element. And Speedomax won't "drift" in accuracy as it ages—it stays on the job and holds the process on spec. If you damage either the sensing element or lead, you simply repair or replace on the job. Speedomax never goes back to the factory for re-calibration, so you do not need spares—thus you save both inventory and storage space.

Anyone familiar with L&N construction will see it again in Type H. The same husky components, anti-friction bearings, rigid assembly and ultra-accessability.

New features include a "fill-in-place" pen; a new, ingenious on-off control switch; more plug-in components. External leads go to a terminal board on outside back of case, for easy installation and maintenance.

One of the round-chart instrument's special features is its long scale; this is used both in setting the control point and for reading temperature. All instruments have especially easy, accurate means for moving the control point setter.

You can choose any type of control action—On-off; Proportional Action; Proportional with rate and reset actions. Any L&N office can supply details and application engineering assistance; or write us at 4955 Stenton Ave., Philadelphia 44, Pa.

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Editorial...

INSTRUMENTS and AUTOMATION

A LOOK AT 1954

AS WE ENTER a new year, and make resolutions for directing our future path, it is fitting to pause and look back at the year whence we came. What can we learn from the immediate past?

Our field is alive with great activity. We reported to you 2306 new instruments. This is a cold statistic, but each new instrument is the loving brain child of dedicated persons, conceived to solve hitherto unsolved problems, to perform hitherto impossible control functions, to penetrate nature's secrets and make mankind's life a bit more full and rich and satisfying. Behind each new instrument is a creative mind, a dedicated labor of love. It is for this reason that the New Instrument Department of *Instruments and Automation* is our first item in the magazine, and the most comprehensive news service of its kind in the world.

In 1954 the nation seemed suddenly to become more aware of the field of instrumentation—measurement and control. The control aspects, particularly, captured the imagination of writers, economists, financiers, authors, publishers. Millions of words were written and spoken about the new industrial revolution, the manless factory, the computer-controlled factory, etc., etc. New magazines appeared in the field. Automation conferences were held by the dozens by societies and universities. But, many of the vague generalities expounded by the speakers (who seemed to rotate from conference to conference, repeating the same generalities) did little good—and some harm. Labor, heretofore cooperative about technological progress, started to wonder about technological unemployment as they read editorial after editorial about manless factories. Engineers, heretofore interested in applications of computers, became aware of the appalling disparity between their plants and the mythical plants being glorified, and started to wonder if they had the electronic or the mathematical background necessary to operate the formula-controlled mathematical and electronic devices. The harm was done because most of the speakers and writers had little practical knowledge of both computers or industry—they were speakers and writers, or men who knew of either computers or industry—but not of both. Hence perspective was lost.

Yet the single most dramatic development of the year was the occasional solution—here and there—of an immediate production and control problem by analog and digital computers. These real achievements were in the simulation, analysis, design, and solution of manufacturing problems. These types of solutions did not displace one laborer; they may never displace any labor. Computers must become general tools in the hands of the plant man long before they become a replacement for the plant laborer and superintendant. The undue emphasis on the latter point in 1954 may have retarded the normal evolutionary development of the former field.

But this normal development is occurring. The First Computer Clinic, held in conjunction with the First Automation Exposition, attracted 200 engineers and executives from 24 basic industries and 26 states of the nation (plus Canada and England). These men were factually introduced to the basic simplicity and applications of computers. Such idea germination will do much to expand the applications of computers in industry, which will occur more rapidly in 1955.

Highlights of the year 1954 were the International Instrument Exposition in Philadelphia and the First Automation Exposition in New York—both managed by your publisher. The former was the largest event of its kind ever held; the latter was unique in that it attracted 10,000 top-level executives and engineers, plus financiers, economists, news services, and others heretofore unfamiliar with the field of automatic control. The Automation Exposition was doubly valuable—it not only opened new markets for the field, but also gave the attendants a practical résumé of the real devices which are the heart of modern automatic control. This show filled a need and earned immediate acceptance. In 1955 it will do much to direct the field of automatic control in practical channels.

A trend revealed at the Instrument and Automation Expositions was increased use of digital techniques—analog-to-digital conversion, direct digitized printout and readout, and data reduction. The Automation Show also emphasized a trend to telemetering and remote control, including new techniques for multiplexing. Also significant in 1954 was the putting on line of the first electronically controlled refinery, the Rock Island installation.

1954 saw also great interest in new transducers, particularly those of use in servo applications; 1954 also

saw increased emphasis on electromagnetic-type and mass-type flowmetering, on new valve operators (pneumatic, hydraulic and electric), on many types and sizes of analog-to-digital converters, on tape and tape handlers (magnetic and punched paper), on magnetic-core memory and arithmetic devices for computers.

Competition between electronic and pneumatic control systems increased. The Rock Island electronic installation reported superior use of derivative control; the pneumatic field countered with plastic tubing that reduced installation costs.

We believe the year ahead will be reflected in the image of the past. The curve is upward—more new instruments, more new principles, more new applications. We rededicate ourselves to serving you, our readers, by honestly and faithfully reporting all these new developments, and by constantly attempting to increase the educational value of *Instruments and Automation*, issue by issue, year by year, as we enter our 28th year of service to the field of measurement and control.

ENGINEERS AND LANGUAGE

Abstracts from a talk by CHARLES A. MAYNARD, Vice President in charge of Engineering and Research, The Indiana Steel Products Co., delivered at The National Electronics Conference, Chicago.

WHAT helps to translate the labors of an engineer or a scientist into action by others? It is most important to realize the nature of the obstacles that must be overcome. Friar Bacon, who was prophet and martyr in the cause of science, being persecuted, exiled from England and cast into prison, came face to face with some of these obstacles in their most virulent form. In his book "Opus Majus," which proclaimed the fundamental importance of experimentation in science, there is this passage: "Now there are four chief obstacles that hinder every man, however learned, from grasping truth . . . namely, submission to ignorant authority, influence of customs, popular prejudice and concealment of our own ignorance." . . . the nature of man has not changed and the same obstacles are present as in the times of Friar Bacon.

While there may be other obstacles that have to be overcome, those indicated by Friar Bacon will serve to illustrate the problem. The means used in overcoming these obstacles will in a large measure be the answer to others that might arise. Any report should be presented with a realization that its interpretation will be based on the background, environment, prejudice and knowledge of those receiving the report.

A common language

It is important that the engineer present his findings in a common language. This will enable one to overcome many prejudices. Too many people, and often the engineer's customer, would readily subscribe to an old definition which is as follows, source unknown:

> "An engineer is a person who passes as an exacting expert on the basis of being able to turn out with prolific fortitude infinite strings of incomprehensible formulas calculated with micrometric precision from vague assumptions which are based on debatable figures taken from inconclusive experiments carried out with instruments of problematical accuracy by persons of doubtful reliability and questionable mentality for the avowed purpose of annoying and confounding a hopeless chimerical group of fanatics referred to, all too frequently, as engineers."

To the engineer it is a joke on himself and not to be taken seriously. Unfortunately, in the minds of some it borders on the truth because their experiences have indicated that engineers act at times as though they are a world unto themselves; also, if the engineer cannot convince them, he can easily confuse them.

It is necessary that a meticulous attempt be made to convey the information as simply as possible. Today there are a number of companies that are giving exhibitions of very complex machines to the public. The explanations concerning the machinery and principles involved are couched in terms that are generally of significance to Mr. Average Citizen. It is not beneath the dignity of an engineer to give up some of the engineering language if in so doing it will serve to a better understanding. There is a good precedent for this if same be needed. It goes back a long way. In setting forth an observation in a common language, one of the basic concepts of physics was developed. About 1025 A.D. one of the physicists of the Mohammedan culture, namely, Abu R Raihan Muhammad ibm Ahmad al-Biruni, invented the overflow method of finding the density of a body. He recognized that others might be unfamiliar with the Persian units of weight and volume. It was his desire to transmit the results that he obtained so that all would understand. Accordingly, he expressed his results independently of any units and introduced the idea of specific gravity, being a ratio of the weight of a body to that of an equal volume of water.

A common language is a great aid in overcoming any prejudice, and it also enables the customer to better evaluate the work that the engineer has done. Do not let the work be hidden in engineering verbiage. Even engineers appreciate a simple presentation if it makes for economy of effort.

Confidence

It is important for an engineer to have confidence in himself and the work that he has prepared. This should not be a glib confidence. It should be the result of a real knowledge of his field, not merely an accumulation of details, important as they may be, but a basic understanding of the principles involved and relative importance of the details. His knowledge should be such that he can relate his field with other fields. He should work so as to accumulate all the necessary facts and factors that will give a true and logical answer, being wary of selecting only those things which will lead to a preconceived answer or idea. Such an honest endeavor will give the engineer the confidence he requires. This confidence and a proper presentation of his endeavors will do a great deal in establishing his work as authoritative.

A true confidence in himself on the part of the engineer will result in his having the confidence of his superior, of the manufacturing group, purchasing, sales and management. It will overcome many an objection such as, "This isn't the way we have been doing it."; "It won't work."; "What we have is good enough." and kindred holdovers that are fetishes of a less enlightened authority.

A principle for engineering presentation

The philosophy expressed in three passages from the poem "Concerning the Nature of Things" by Lucretius, a scientist and poet in the times of Julius Caesar, may well serve as a guiding principle in the engineering presentation. He writes:

"Now apply your mind, I pray, to a true reasoning; for a truth wondrously new is struggling to reach your ears, and a new view of creation to reveal itself . . .

"Nor am I unaware of the difficulty of expounding in Latin verses the abstruse discoveries of the Greeks, especially when many of the notions necessitate the coining of new words because of the poverty of our language and the novelty of the ideas . . .

"But your merit and the anticipated pleasure of your sweet friendship urge me to undertake any toil and induce me to keep vigil through the silent nights, searching by what words, yea and in what measures, to spread before your mind a bright light by which you may examine deeply into hidden truths . . ."

The Sales Engineer

Fortunately, the sales engineer is not generally faced with the necessity of convincing the masses. His customers are individuals and groups. . . . The engineer's problems mean little to his customer. Fundamentally, customers want to know what will it do for them? There is a poem that sums up these ideas from the customer's point of view entitled, "Tell Me Quick and Tell Me True (or else, my love, to hell with you)" by Victor O. Schwab. It reads as follows:

I see that you've spent quite a big wad of dough
To tell me the things you think I should know.
Now your plant is so big, so fine, and so strong;
And your founder had whiskers so handsomely long.
So he started the business in old '92!
How tremendously int'resting that is . . . to you.
He builds up the thing with the blood of his life?
(I'll run home like mad, tell that to my wife!)
Your machinery's modern and oh so complete;
Your "rep" is so flawless; your workers so neat.
Your motto is "Quality" . . . capital "Q" - -
No wonder I'm tired of "Your" and of "You"!
So tell me quick and tell me true
(Or else, my love, to hell with you!)
Less—"how this product came to be";
More—what the damn thing does for me!

Will it save me money or time or work;
Or hike up my pay with a welcome jerk?
What drudgery, worry, or loss will it cut,
Can it yank me out of a personal rut?
Perhaps it can make my appearance so swell
That my telephone calls will wear out the bell;
And thus it might win me lots of fine friends—
(And one never knows where such a thing ends!)
I wonder how much it could do for my health?
Could it show me a way to acquire some wealth—
Better things for myself, for the kids and the wife,
Or how to quit work somewhat early in life?
So tell me quick and tell me true
(Or else, my love, to hell with you!)
Less—"how this product came to be";
More—"what the damn thing does for me!"

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New Instruments...

INSTRUMENTS and AUTOMATION

PROCESS MONITORING and CONTROL

Process Instrumentation

New "Speedomax Type H" self-balancing null-method indicators, recorders and controllers supplement (but

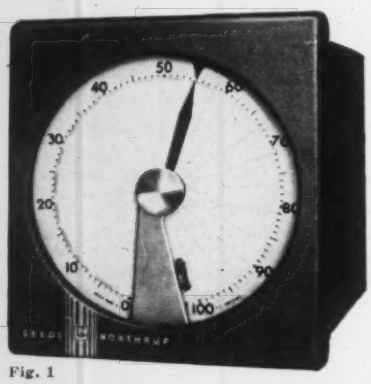

Fig. 1

do not replace) maker's more versatile "Speedomax Type G"; are smaller and made in single-point only; are entirely new structurally. Indicators, round-chart and strip-chart recorders, on-off indicating controllers and on-off recorder-controllers are 12 in. high (see Fig. 1). Proportional-mode controllers, whether indicating or recording, include a "Series 60 Control Unit" described elsewhere in this issue, and are all 17⅝ in. high (see Fig. 2). Con-

Fig. 2

venience features include chart feed, pen and control setters; also location of thermocouple terminals, etc., in a recess on outside back of instrument. —*Leeds & Northrup Co.*, 4955 *Stenton Ave., Philadelphia* 44, *Pa.*

For more information circle **201** on inquiry card.

Supervisory Control

New supervisory control system is for use with any type of communications equipment capable of carrying audio signals, including microwave and VHF radio as well as power line carrier and wire lines. Installation and maintenance costs for long distances are much lower than those of conventional remote control apparatus using multiconductor cables. New system enables an operator to control and supervise remote valves, pumps, generators, motors, etc., and it continuously indicates their position. Alarms can be added to signal high or low voltages, levels, temperatures, pressures, flows, etc. Two-step "select before operate" sequence helps prevent errors. Any number of remote devices desired for multiple operation can be selected in

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usual manner and then operated on at the same time; for example, a number of valves could be selected and all opened at the same time by pushing a "master operate key" once. New system uses specific audio tones in a "coded" sequence, thus assuring that no false indications of operation can result from noise pulses that might occur in transmission medium. Not only must tones be present, but their frequencies must be within narrow limits of accuracy or operation is prevented. But no synchronization or adherence to close time tolerances is required. Heart of new system is "Vibrasender" electromechanical resonant device that generates an extremely stable tone code which can be used to operate "Vibrasponder" companion resonant relay. Up to 90 individual points can be controlled and/or supervised by using 12 different tones. "Building block" design permits almost unlimited expansion of system. With a multi-terminal system, one master console controls up to ten remote stations. System can also be designed to provide selective telemetering of instrument readings.—*Motorola Communications and Electronics, Inc.*, 4501 *Augusta Blvd., Chicago* 51, *Ill.*

For more information circle **202** on inquiry card.

Recorder-controller

New recorder-controller features sensitivity of 0.05 percent of scale range, accuracy of 0.25 percent of scale range, and 4 seconds for full-scale pen travel; is available in emf-measuring or resistance-measuring

circuits; 23 ranges; 12-in. round chart. Two control types: (1) two-position for batch processes, etc., (2) pulse-proportional for continuous processes, etc., with proportional band continuously adjustable from 0 to 20 percent.—*Thermo Electric Co., Inc., Saddle River Township, Rochelle Park P. O., N. J.*

For more information circle **203** on inquiry card.

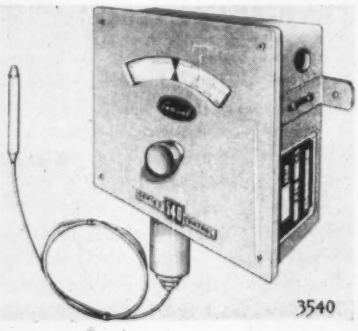
Remote Controller

New remote controller for Grove Regulator utilizes a reversible motor with an automatic brake for quick stops. Limit switches eliminate overtravel. A voltage-dividing resistor, provides variable resistance for position indicator at remote control station.—*Test Equipment Div., Avionics Products Engineering Corp., Dover, N. J.*

For more information circle **204** on inquiry card.

Temperature Controller

New "Series 540" is a low-cost indicating temperature controller accurate within one percent of full scale under most conditions. Range 100 to 700 F., flush- or surface-mounted, as desired. D-p.d-t. relay is rated 15

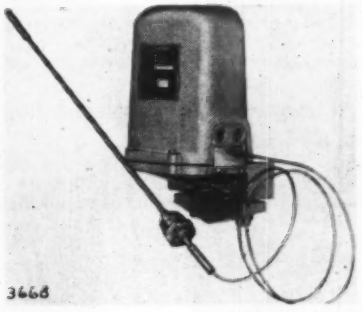


amps. Differential can be varied between 0.8 percent and 4 percent of scale range. Bellows assembly is self-compensating for changes in ambient temperature in range of 50 to 150 F. Unit may be exposed to –65 F. indefinitely without damage.—*Fenwal Inc., Ashland, Mass.*

For more information circle **205** on inquiry card.

Temperature Transmitter

New "Model 12A" comprises a gas-filled thermal system with a force-balance 3-15-psi. pneumatic transmitter and built-in compensations for variations in ambient temperature and barometric pressure, so that over-all accuracy is 0.5 percent. Available in



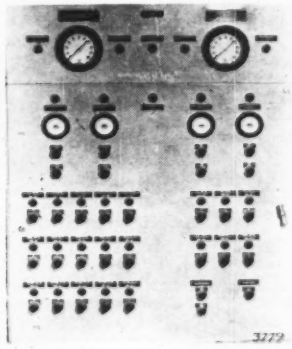
3668

spans 50-F.deg. to 400-F.deg. spans between limits of –100 deg.F. and 1000 deg.F. Instrument weighs 7 lbs., is completely waterproof, can be installed in hazardous areas and in corrosive atmospheres.—*The Foxboro Co., Foxboro, Mass.*

For more information circle **206** on inquiry card.

Control Systems

New "Package Control Systems" for machines and processes are of-



3772

fered; are said to "defy broad general descriptions."—*John C. Whiddett Co., 9 Union Ave., Bala-Cynwyd, Penna.*

For more information circle **207** on inquiry card.

Automatic Controller

New "Series 60 Control Unit" replaces maker's "Series 50" and takes about half panel space of earlier controller; fetaures simplicity, inter-

DUBROVIN VACUUM GAUGES

Compact Practical Gauges For Moderately Reduced Pressures

•

Range: 0.2 mm To 20 mm of Hg

•

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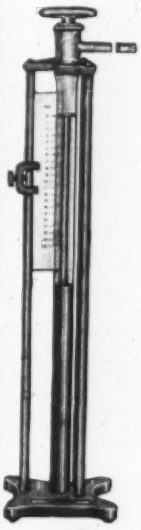
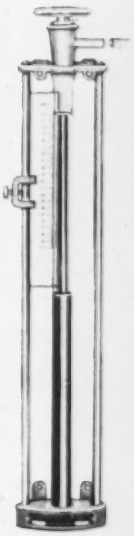


No. 1451C. Table Mounting

The Dubrovin Gauge indicates the pressure continuously, may be left in the system indefinitely, and is not damaged if the line is suddenly opened to atmospheric pressure. It is simple to install and convenient to use. A typical application for which it has proved especially convenient is the filling of tubes with gas at a specified pressure, as in the luminous-tube industry. It is useful wherever a sensitive gauge of this range is needed.

There are two basic types, one 9 times and the other 6 times as sensitive as a mercury manometer. Because of this "magnifying factor", the gauge is as sensitive as a manometer which uses a liquid of low density, but has the advantage of using mercury which dissolves very few organic or inorganic vapors and which requires no conversion factor. Unlike mechanical or optical magnifying devices, any small errors due to capillarity, adhesion, etc., are not magnified. The smallest division on the 9-to-1 type is 0.2 mm and on the 6-to-1 type is 0.5 mm of Hg. Fractions of these values may be estimated. Both types are available with Pyrex-brand or soft glass in either a table or wall mounting.



No. 1451H. Wall Mounting

The Dubrovin Gauge consists of a stainless-steel cylinder, of small diameter and closed at one end, floating vertically in mercury with its open end submerged and with the air evacuated from the chamber thus formed. The outer tube, in which the cylinder and mercury are enclosed, is of glass mounted in a metal frame and connected to the vacuum line. An adjustable scale on the metal frame is read by an indicator at the top end of the floating cylinder.

To set up, the gauge is first evacuated by a good mechanical pump to about 1 micron while being supported on its side so that air will be removed from the floating cylinder. It is then set upright and the scale adjusted until the index reads zero. The gauge may then be opened to atmospheric pressure and installed in any vacuum line, care being taken not to incline it such that air re-enters the float.

Cat. No.	Pressure Range mm of Hg	Magnifying Factor	Merc. Req'd, Lbs.	Material of outer tube	Mounting	Each
1451C	0.50 to 20	6	1	soft glass	Table	$44.50
1451D	" " "	"	"	Pyrex Brand	"	44.50
1451G	" " "	"	"	soft glass	Wall	44.50
1451H	" " "	"	"	Pyrex Brand	"	44.50
1451E	0.2 " "	9	2¼	soft glass	Table	52.50
1451F	" " "	"	"	Pyrex Brand	"	52.50
1451J	" " "	"	"	soft glass	Wall	52.50
1451K	" " "	"	"	Pyrex Brand	"	52.50

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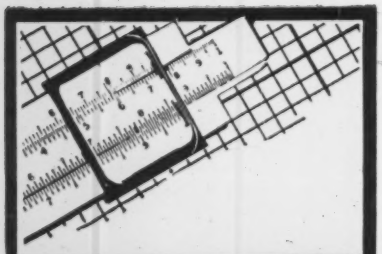

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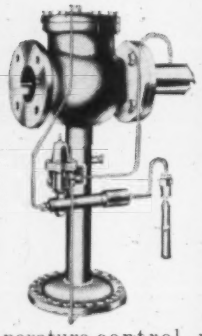
changeability, plug-in construction and advances in sensitivity, speed and flexibility. Available in three types: (1) position-adjusting, (2) duration-adjusting (both with proportional, automatic reset and rate actions) and (3) simple proportional control with reset but without rate action.—*Leeds & Northrup Co., 4955 Stenton Ave., Philadelphia 44, Pa.*

For more information circle **208** on inquiry card.

Temperature and Pressure Controller

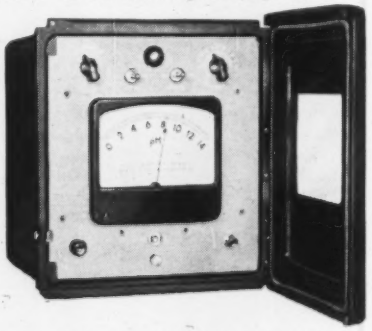


New "No. 1649" features a single main valve giving both temperature and pressure control to prevent hunting, cycling or overheating. In operation, it is set to meet maximum pressure demand under command of pilot valve downstream; and temperature-control pilot shuts main valve when temperature control point is reached (regardless of downstream pressure). Pressure range 5 to 125 psi.; temperature adjustment range 50 F. deg. for each unit, with extremes at 25 deg. F. and 275 deg. F. for entire line.—*Klipfel Valves, Inc., Hamilton, Ohio.*

For more information circle **209** on inquiry card.

pH Indicator

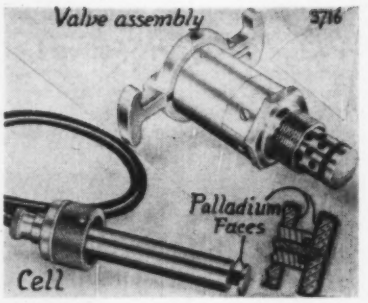
New panel-mounted indicator for continuous measurement of pH or redox is moisture-proof, gives accurate readings after less than a 1-minute warm-up without use of desiccants; is unaffected by line voltage surges, electrical pick-up, and zero drift.—*Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.*



For more information circle **210** on inquiry card.

Conductivity Cell and Valve Assembly

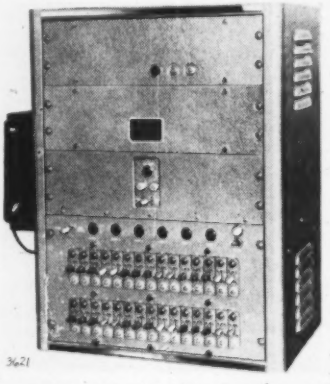
New coaxial disk type electrical-conductivity cell and valve assembly for detecting salt content and other impurities in fluids provides a uniform and unrestricted conduction path with little random losses, and consequent greater accuracy of measurement than with previous cells. Automatic temperature compensation according to MIL-S-15103B can be included if desired. New cell is available in sizes down to ¾ in. NPT; uses "Kel F" to insulate electrodes. Assembly is available in brass, nickel-plated brass or stainless.—*McNab Inc., 225 Lafayette St., New York 12, N. Y.*



For more information circle **211** on inquiry card.

Supervisory System

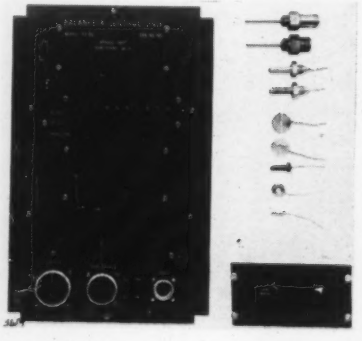
New "Electro-Span" digital supervisory control system, for remote measurement and for such control functions as remote shaft positioning, on-off switching, and proportional control, may be used in conjunction with any electrical transmission medium, including telegraph circuits, telephone lines, VHF radio or microwave links. Voice communication can be time shared where voice channel bandwidth exists.—*Dept. 831, Pacific Div., Bendix Aviation Corp., 11600 Sherman Way, N. Hollywood, Calif.*



For more information circle **212** on inquiry card.

Temperature Monitor

New "CTI" is a temperature measuring, indicating, and warning system for industrial, airborne, and laboratory use; monitors temperatures at many locations simultaneously. When pre-determined temperature is reached, an indicator lamp flashes on and remains lit until temperature returns to normal. Indicating instru-

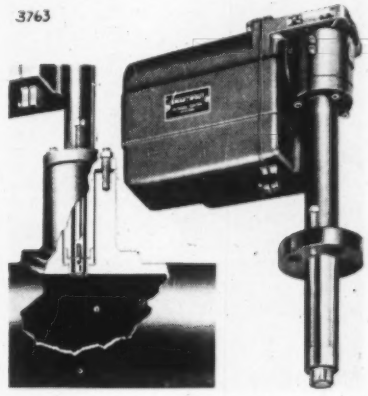


ment can be switched to any channel for direct reading of channel temperature in percentage of critical temperature. Balance and power unit supplies power for probe excitation and contains adjustments for setting range, span, and warning temperature of each channel. System uses magnetic amplifier circuitry throughout. Absence of electronic tubes and relays is said to make system "extremely stable, highly reliable, and very rugged."—*Dep't IA2, Arnoux Corp., 1357 S. Hawthorne Blvd., Hawthorne, Calif.*

For more information circle **213** on inquiry card.

Pressure Transmitter

New "P3T Flush Diaphragm Pressure Transmitter" features absence of stagnant pressure lines; permits pressure measurements at temperatures

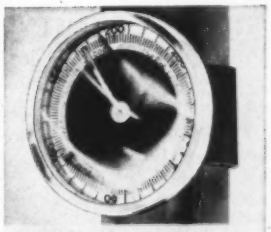


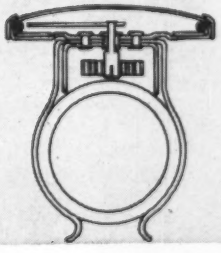
up to 300 C.; has all parts in contact with fluids made from stainless steel; can be used in any position. Transmitter's output varies from 0 to 0.500 v.ac. in direct proportion to pressure being measured. Pressure ranges of 0-200 to 0-1000 psig. and 0-1000 to 0-2500 psig. Sensitivity better than 0.005 percent; reproducibility 0.1 percent; accuracy 1 percent.—*The Swartwout Co., 18511 Euclid Ave., Cleveland 12, Ohio.*

For more information circle **214** on inquiry card.

Pipe-surface Thermometer

New Pipe Surface Thermometers, for pipes and tubes from ½-in. to 2-in. O.D., are quickly fastened by means of a spring clip without use of any





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. . . to help you control small flow rates easily and accurately. The needle point in a Hoke Metering Valve is just 8° wide and it takes 20 turns of the handle to move the point ⅜ of an inch, the effective throttling length. In addition to this precise control, the Metering Valve has an O-ring stem seal (. . . so tight it'll pass a Helium Leak Test) and is available for instrument panel mounting.

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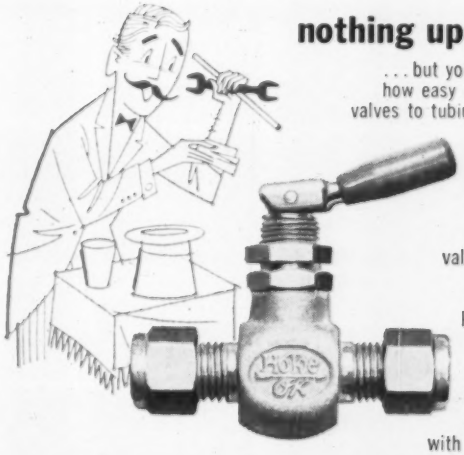

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For more information circle **46** on inquiry card.

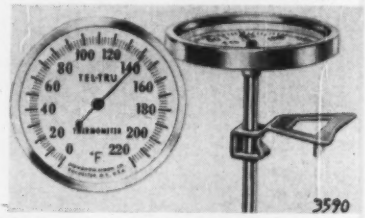
tools. Available in two ranges: –50 F. to 250 F. and 70 F. to 370 F.—*Pacific Transducer Corp.*, 11836 *West Pico Blvd., Los Angeles* 64, *Calif.*

For more information circle **215** on inquiry card.

LABORATORY

Testing Thermometer

New "GT-100" general-purpose testing thermometer of 18-8 stainless steel, is hermetically-sealed and non-frosting; may be safely submerged in

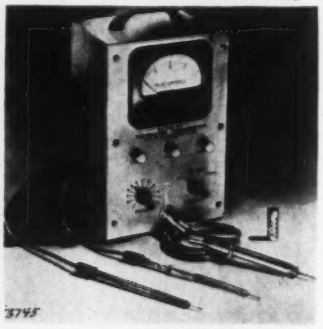


solutions. Accuracy guaranteed 0.5 percent of dial range; no damage from over-temperature; bimetallic element silicone-damped. Various stem lengths and C. and F. ranges.—*Tel-Tru Mfg. Co.*, 408 *St. Paul St., Rochester* 3, *N. Y.*

For more information circle **216** on inquiry card.

Thermistor Thermometer

New multi-range thermistor thermometer features accuracy of 0.1 C.deg. and rapid response; may be calibrated in user's laboratory for



various reading ranges. Three types of available thermal elements cover ranges between limits of –10 C. and 200 C.: metal-shielded for permanent mounting and glass styles for replacement of mercury-in-glass thermometers. Case contains a Wheatstone bridge with dry cell power and a microammeter.—*E. H. Sargent & Co.*, 4647 *W. Foster Ave., Chicago* 30, *Ill.*

For more information circle **217** on inquiry card.

Signal-light Thermostat and Thermoregulator

New models of maker's fixed-setting thermostats and "Quick Set" thermoregulators (all of mercury-in-glass type) have a color signal mounted on top of instruments. Lamp lights only while temperature is rising and shuts off when temperature is reached, thus freeing operator for other tasks during heating period. Sensitivity is 0.02 F. degree.—*Philadelphia Scientific Glass Co.*, 1866 *Eckart Ave., Abington, Penna.*

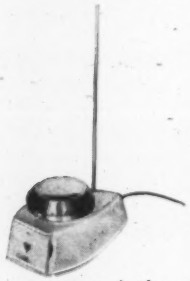
For more information circle **218** on inquiry card.

Magnetic Stirrer

New "King-size Magne-Stir" supplements regular size "Magne-Stir," features built-in hot plate for heating and stirring simultaneously, and "egg-bars" with Teflon or glass coverings.—*Labline, Inc.*, 217 *N. Desplaines St., Chicago* 6, *Ill.*

For more information circle **219** on inquiry card.

Hot Plate and Stirrer



New "Lanco" combined hot plate and magnetic stirrer has a light casting base which houses controls for heating and stirring and stirrer motor. Hot plate assembly plugs into top of base and is easily removable. Stainless steel support rod threads into base. With each unit is supplied a glass-enclosed stirring magnet. Infinitely-variable heating from 0 to 400 watts. Stirring and heating are independent of each other and can be used separately or together. Motor and magnet are fan-cooled for long life.—*Arthur S. La Pine & Co.*, 6001 *S. Knox Ave., Chicago* 29, *Ill.*

For more information circle **220** on inquiry card.

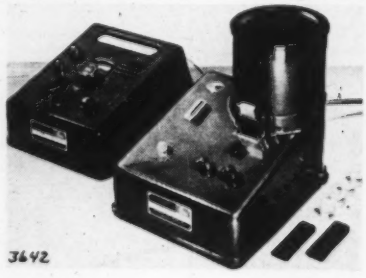
Stirring Paddle

New "Flexi-stir" thoroughly agitates contents of any container of not less than ⅝-in. diameter; comprises a stainless steel rod with flexible stainless steel chain paddle. Two standard sizes: 10 x ¼ in. and 12 x 5/16 in.; specials to order.—*Palo Laboratory Supplies, Inc.*, 81 *Reade Street, New York* 7, *N. Y.*

For more information circle **221** on inquiry card.

Photofluorometer

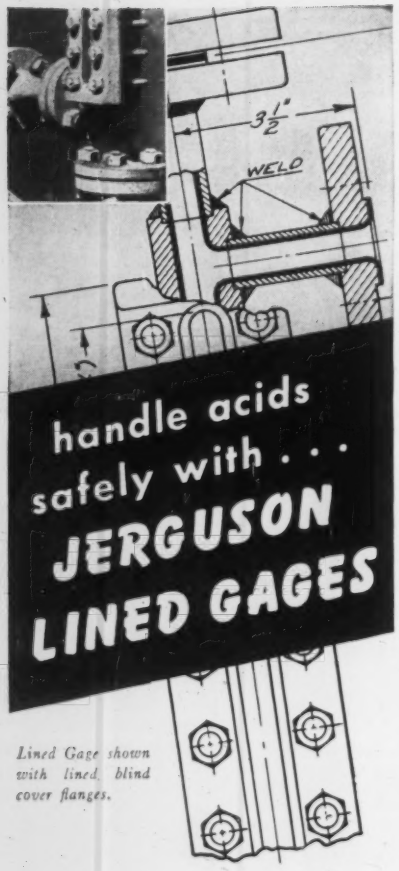
New "Model 12C" photofluorometer, based on "Model 12," offers a greatly increased sensitivity and improved



Available in *all* standard panel instrument sizes, equipment designers now can specify ruggedized meters in the exact size required for any built-in equipment need. For complete information on WESTON Ruggedized Panel Instruments, including types and ranges available, communicate with the Weston representative in your vicinity, or write direct to . . . WESTON Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, N. J.

WESTON INSTRUMENTS

For more information circle **47** on inquiry card.



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WHERE concentration of liquids such as sulphuric, muriatic or other acids necessitates equipment with special linings, Jerguson can furnish you with reflex or transparent gages lined with natural and synthetic rubbers, lead, phenolic base compounds, Teflon, and other materials. Jerguson Lined Gages are designed to meet your requirements of long-life and dependable operation.

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Pétrole Service, Paris, France

For more information circle **48** on inquiry card.

NEW INSTRUMENTS

stability which enable it to deliver accurate data both at very faint fluorescence levels and lower concentrations than those previously convenient to handle.—*Coleman Instruments, Inc., Maywood, Ill.*

For more information circle **222** on inquiry card.

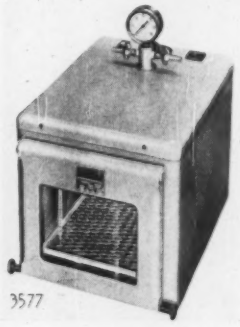
Spectrometers

Two new types of maker's improved model direct-reading spectrometers are: (1) new research model for improved analytical facility in handling a wider range of materials under diverse conditions of sample concentration, range, excitation, elements and matrices; (2) new production-control "Direct Reader" for routine control problems where basic changes in production are not anticipated. Both instruments provide (a) increased stability through a newly designed optical mount and (b) simplified and accelerated operation and service by means of redesign of sample compartment and electronic components. —*Baird Associates, Inc., 33 University Road, Cambridge 38, Mass.*

For more information circle **223** on inquiry card.

Vacuum Oven

New "Thelco" vacuum oven uses ribbon-type heater elements operating at black heat; has a hydraulic thermostat with external adjustment knob,

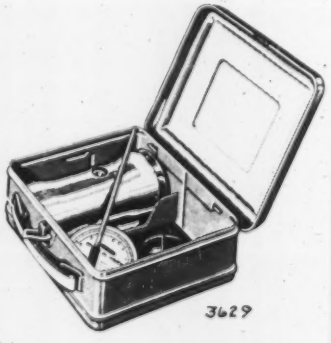

3577

stainless steel drip pan, new-formula neoprene rubber gasket, door hinged at top for easier closing and minimal space.—*Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.*

For more information circle **224** on inquiry card.

Gas Analysis Kits

New "Kwik-Chek Gas Analyzers" are available for carbon dioxide, oxygen, or both; include all needed components and instructions; require no

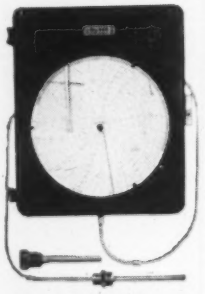

3629

4½" DIAL THERMOMETERS

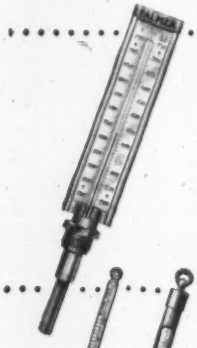
Made in 3 types to suit any requirements. Rigid stem, wall or flush mounted, 11 inches of scale reading. Interchangeable with standard industrial separable sockets. Stem can be placed at any angle and case can be rotated to any readable position.

PALMER
MERCURY ACTUATED
Temperature Indicating Instruments

RECORDING THERMOMETERS



Twelve inch die-cast aluminum case with black or white wrinkle or satin finish. Single or multiple pen construction. Electric or spring wound clock, 24 hour or 7 Day Revolution. Flexible Armor and bulb of stainless steel. Ranges —40 +950°F or Equivalent in °C.



INDUSTRIAL THERMOMETERS

Red-Reading Mercury —Extruded brass case — chrome finish. Ranges —40 + 950°F or Equivalent in °C.

RED-READING MERCURY LABORATORY THERMOMETERS

Thoroughly annealed for permanent accuracy. Complete line A.S.T.M. and fractional division types.

Write For Catalog Information

PALMER
THERMOMETERS, INC.
Cincinnati 12 Ohio • MEtrose 1500

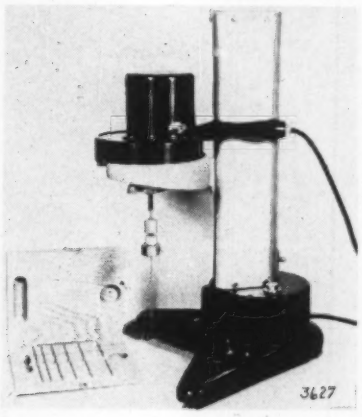
For more information circle **49** on inquiry card.

skill. Solution replacement is said to be as easy as changing a light bulb.—*Burrell Corp., 2223 Fifth Avenue, Pittsburgh 19, Penna.*

For more information circle **225** on inquiry card.

Viscometer and Stand

New models of "Synchro-Lectric Viscometer" and "Helipath" stand make possible precise testing of highly plastic materials regardless of de-



gree of thixotropy. Motor-driven stand lowers rotating spindle through test material, thus enabling accurate study of non-flowing substances such as gels, pastes, greases, etc.—*Brookfield Engineering Laboratories, Inc., 240 Cushing St., Stoughton, Mass.*

For more information circle **226** on inquiry card.

PHOTOGRAPHY, etc.

Subminiature Camera

New (to the U.S.) "Minox" is said to be "the most fabulous miniature camera in all the world, developed originally for espionage," is carried in pocket like a cigarette lighter (di-

mensions 1x3x0.6 in.); has F:3.5 15-mm. focal-length lens; focusing of range from 8 in. to infinity; automatic parallax correction at all distances; eleven shutter speeds from 0.5 to 0.001 sec.; built-in green and orange filters. Genuine alligator leather case.—*Kling Photo Corp., 235 Fourth Ave., New York 3, N. Y.*

For more information circle **227** on inquiry card.

Tripod

New "Triumph Standard" tripod combines minimum weight (6 lbs.) and maximum sturdiness. Steel spikes may be converted into rubber tips

Mass Spectrometry . . .
on a practical industrial basis

Two companion instruments, Types 21-610 and 21-620, now extend the speed and accuracy of mass spectrometric analysis from the laboratory out into the plant. Flexible and simplified, needing only 115 volts and a small supply of cooling water, the twin instruments are easily adaptable to process-stream monitoring, batch work, or leak detection.

For monitoring & controlling streams to mass 60. . .

For higher resolving power, readings to mass 150. .

TYPE 21-610 is moderately priced and a truly general-purpose instrument. Although primarily designed for continuous petroleum and petrochemical stream analysis, it is also valuable as a production-line leak detector or laboratory analytical instrument. It has been used in applications ranging from on-the-spot acetylene-plant monitoring to hospital clinical tests on lungs.

TYPE 21-620 has the highest mass range of any instrument in its compact size range. Using the newly developed "Cycloidal Focusing" principle for analysis, it goes beyond the 21-610 for accurate readings from mass 2 to mass 150. Medical laboratories, petro-chemical plants and general research organizations will all find it an ideal answer to their analytical problems.

Modifications . . . accessories

The 21-610 may be converted to a 21-620 whenever the latter's greater resolving power is needed. The work is accomplished by a CEC Field Service Engineer without return of the instrument to the factory. Involving primarily the exchange of some components and the addition of certain others, the conversion is made reasonably and quickly.

An extensive accessory line greatly broadens the utility of both the 21-610 and 21-620. Automatic peak selectors scan as many as six mass numbers on a repetitive cycle; sampling probes and magnet shunts make either instrument a practical production-line leak detector; batch-sample inlet systems and continuous-chart recorders (left) may be mounted directly on the instruments.

How industrial mass spectrometry can be used in *your* business is explained in Bulletin CEC 1824A-X10. Send for your copy.

Consolidated Engineering
Corporation

ELECTRONIC INSTRUMENTS FOR MEASUREMENT AND CONTROL

300 North Sierra Madre Villa, Pasadena 15, California

Sales and Service Offices Located in: *Albuquerque, Atlanta, Buffalo, Chicago, Dallas, Detroit, New York, Pasadena, Philadelphia, Seattle, Washington, D. C.*

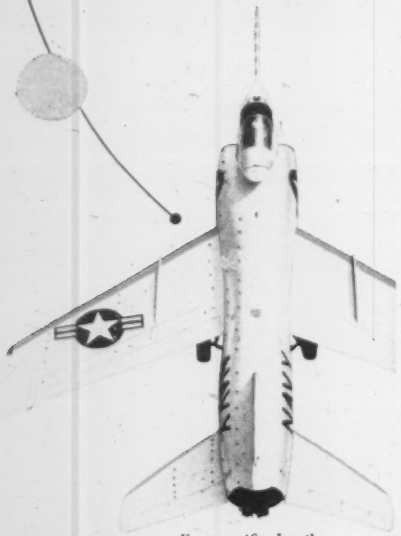
For more information circle **50** on inquiry card.

spots instead of stripes

for the tiger of the sky

The all-white prototype Grumman F9F-9 Tiger is polka-dotted with unpainted circles surrounding static pressure orifices. There are more than 250 of these points on the left side of the airplane.

The Navy's new supersonic jet fighter is instrumented with Statham Model P81 Pressure Transducers for determination of pressure distribution in flight.



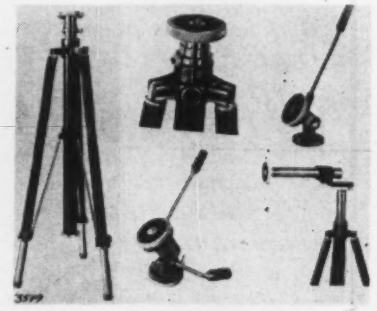
For specific details pertaining to Statham Pressure Transducers, please request Bulletin No. PT-1.

Statham LABORATORIES

Los Angeles 64, Calif.

For more information circle **51** on inquiry card.

NEW INSTRUMENTS



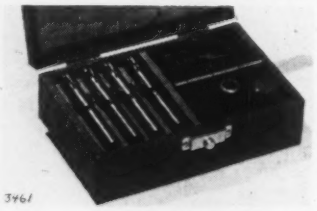
(which cannot fall off) and vice versa. Center column extends for fast adjustment and can be turned at any height; its air dashpot prevents sudden dropping of camera.—*Karl Heitz, Inc., 150 W. 54th St., New York 19, N. Y.*

For more information circle **228** on inquiry card.

NUCLEONICS

Dosimeter Kit

New kit comprises dosimeter charger "L-21K" built into one end of a small leatherette-covered case which has a compartment with clips to hold several quartz-fiber-type direct-reading dosimeters. Provision for

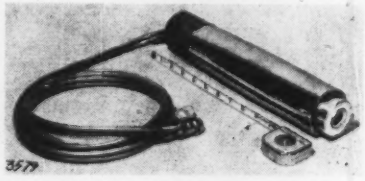


adjusting voltage of charging socket. Switch for light and for voltage circuits is automatically closed when a dosimeter is inserted into socket. One size-D flashlight cell will charge a dosimeter many hundreds of times.—*Landsverk Electrometer Co., 550 W. Garfield Ave., Glendale 4, Calif.*

For more information circle **229** on inquiry card.

Well-counting Assembly

New "Model LAX14P Scintimeter," mounted in new specialized "Model 14L-3" shield, makes up an assembly ideally adapted to counting gamma radiation at maximum sensitivity and



to changing samples at maximum speed. New well counter is of greatest value in clinical and laboratory studies where samples are small and specific gamma activities are at levels as low as 0.00001 microcuries per milliliter. —*R-C Scientific Instrument Co., 307 Culver Boulevard, Playa del Rey, Calif.*

For more information circle **230** on inquiry card.

It's the new ADVANCE SQ—a telephone type that hits a new high in ruggedness and efficiency!

Only 15 milliwatts per pole will operate the new SQ relay in the DPDT combination. Here is sensitivity teamed with stable performance—the DPDT unit withstands 10 G's vibration from 10 to 500 cycles. When power is increased to 40 milliwatts per pole, vibration resistance rises to 30 G's. A single-coil relay, the ADVANCE SQ is available in 1- to 5-amp contact ratings, and in contact combinations from SPST to 6PDT. It comes through Signal Corps tumbling and shock tests in excess of 200 G's with operating characteristics unimpaired.

Sustained efficiency keynotes SQ operation. The use of a beryllium copper armature retaining spring insures positive contact between armature and pivot points at all times. Cross-bar palladium contacts are always properly aligned. A wide variety of coil resistances is feasible. Instead of organic insulation, the unit employs Silicone glass, Kel-F, or Teflon tubing. Life expectancy for 5-amp, non-inductive loads is 150,000 cycles... for 1-amp, non-inductive load: 1,000,000 cycles.

Open type dimensions are 1" x ¾" x 1⅝". DPDT units are supplied in a sealed container measuring 1" x 1" x 2". Write for literature on the SQ series.

ADVANCE RELAYS

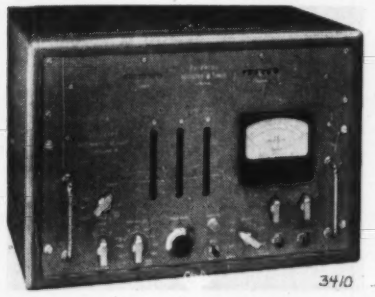
ADVANCE ELECTRIC AND RELAY CO.
2435-H NORTH NAOMI ST.
BURBANK, CALIFORNIA

Sales Representatives in Principal Cities of U. S. and Canada

For more information circle **52** on inquiry card.

Radioactivity Scaler

New "Model 2020 Decimatic" features non-overloading input amplifiers —choice of 0.2 volts or 1 mv. input

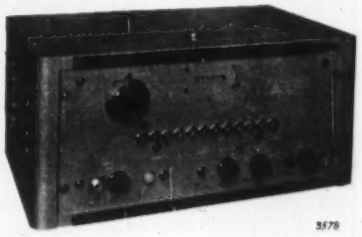


sensitivity; 10-turn discriminator control 5 to 50 v.; preset time and count; electrical reset of register, timer and scaling circuits with single switch; precision h.v. supply with coarse and fine adjustments; "Modular" construction whereby user can modify arrangement at any time.—*Berkeley Div., Beckman Instruments, Inc.* 2200 *Wright Ave., Richmond, Calif.*

For more information circle **231** on inquiry card.

4096 Scaler

New "Mark 13" utilizes known reliable circuits but also new and circuits and features; is of Higinbotham type with a Pentode Schmidt Trigger Discriminator input; resolution ap-

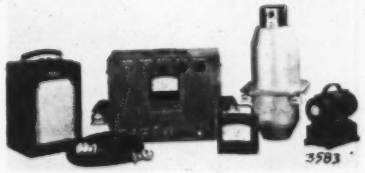


prox. one microsecond; cascade connection for series operation of two scalers. Reliability is enhanced by a scale change switch by factors of four. —*Radiation Counter Labs. Inc.*, 5122 *W. Grove St., Skokie, Illinois.*

For more information circle **232** on inquiry card.

Airborne Survey Instrumentation

New "Model SC-10" equipment for airborne or ground geological surveys detects weak gamma ray fields associated with radioactive mineral bearing ores; features extreme sensitivity (better than 100 counts per second per



micro-roentgen per hour). Equipment comprises a detector head which contains an 8-in. "Plastifluor" crystal and a 5-in. photo-multiplier tube; rateameter (full-scale rates of 1000, 2000, 20,000 and 40,000 counts per second

PRECISE PERFORMANCE AT A NEW LOW COST

($6.25 ea. in quantities of 1000 or more)

FOR ALL PNEUMATICALLY OPERATED INSTRUMENTS, CONTROLLERS, POSITIONERS AND RECORDERS

The New Kendall Model 55 Air Pressure Regulator provides a uniformly clean, dry, drift-free air supply. It is a "package" unit that combines these features:

- Good flow capacity (up to 15 C.F.M.) plus automatic relief
- Water separation with extremely large dripwell capacity plus pushbutton drain valve
- Adjustable output regulation
- Compact, light, rugged - quality construction throughout

Try the model 55 on your own equipment
- AT OUR EXPENSE

To prove the advantages of the new Model 55, Kendall will furnish equipment manufacturers with one Model 55 at no cost, for test purposes on your own installations. All requests made by individuals on their own company letterheads will be honored but Kendall reserves the right to limit the offer to those having actual applications. Furthermore, the offer may be withdrawn at any time at Kendall's option. Outline your requirements now and send for technical data.

"Engineered Air Regulation"

KENDALL CONTROLS CORP.
144 MOODY ST., WALTHAM 54, MASS.

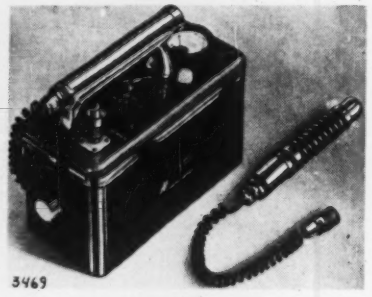
For more information circle **53** on inquiry card.

and time constants of 0.1, 1.0 and 10.0 seconds); external meter and extension cable; provision for a 1-ma. chart recorder. D-c. to a-c. converters are available.—*Sherwin Instrument Co. Inc.*, 2875 *Broadway, New York, N. Y.*

For more information circle **233** on inquiry card.

Portable Survey Meter

New "Model 2612" (completely redesigned) is a battery-operated G-M survey meter for measuring alpha, beta and gamma radiation; features rugged waterproof construction; is

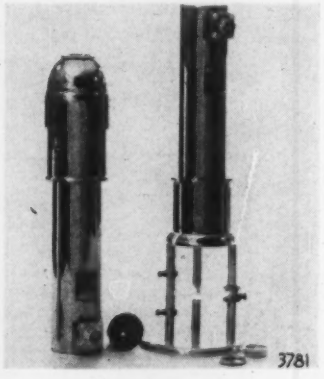


provided with choice of probes. Ranges 0.2, 2, or 20 milliroentgens/hour full-scale. A calibrated radiation source is mounted on case.—*Nuclear Instrument and Chemical Corp., 229 West Erie Street, Chicago* (10) *Illinois.*

For more information circle **234** on inquiry card.

Scintillation Counters

New "SC-2M" scintillation counter (shown first with detachable collimator in place and again mounted in



sample changer "CH-1M") has length of collimator adjustable and small insert shown may be used to change size of the aperture from 1 in. to ½ in. Plateaus obtained with this counter are flat for 300 volts. ★ "SC-1U" is a universal scintillation counter, similar in appearance and characteristics to "SC-2M," with interchangeable crystals for counting alphas, betas, gammas and neutrons.—*N. Wood Counter Lab.*, 5491 *Blackstone Ave., Chicago* 15, *Ill.*

For more information circle **235** on inquiry card.

Viking miniature connectors

DESIGNED FOR LONG, RELIABLE SERVICE LIFE

VIKING circular types. Positive polarization and shielding. Simple locking device mates units against vibration. One to four contacts on small units—5 to 9 on large units.

VIKING printed circuit receptacle. Increases your circuits—unit shown has 20 contacts, and is interchangeable with 18-contact types. Extremely strong contacts, pierced or unpierced.

Hermetic sealing is available on the circular and rectangular series. Write for literature on these or the complete line of VIKING connectors.

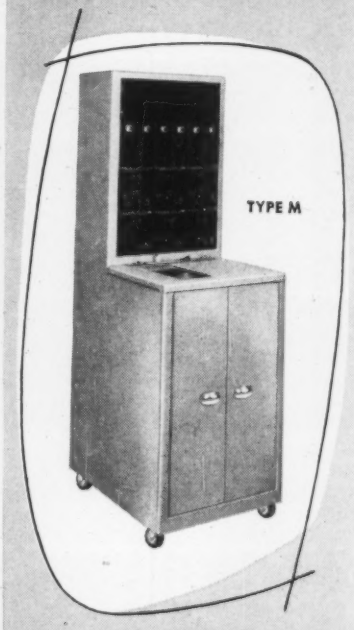
VIKING ELECTRIC

1061 INGRAHAM STREET

LOS ANGELES 27, CALIF.

For more information circle **54** on inquiry card.

ONE AMPLIFIER FOR ALL APPLICATIONS



OFFNER DYNOGRAPH RECORDER

This high speed, direct writing oscillograph *requires only one amplifier* to record all types of a-c and d-c inputs for measuring speed, temperature, position, vibration, and for both strain and reluctance gauges. *Compare* the Dynograph with other instruments that require *three or more separate amplifiers* to cover these uses.

The Dynograph has many other desirable features such as rapid pen response, absolute drift-free stability, *microvolt* sensitivity—all made possible by the exclusive patented chopper amplifier design.

Bulletin L-742 provides complete specifications and detailed information concerning applications. Write today for your free copy.

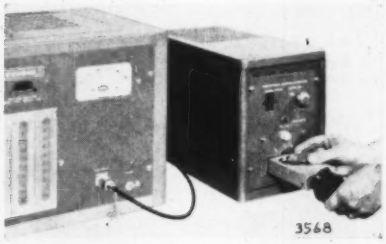
OFFNER ELECTRONICS INC.

5326 N. Kedzie Ave., Chicago 25, U. S. A.

For more information circle **55** on inquiry card.

Proportional Counter

New "Model PCC-14" with built-in low-voltage power supply and needle valve for gas flow control, converts any

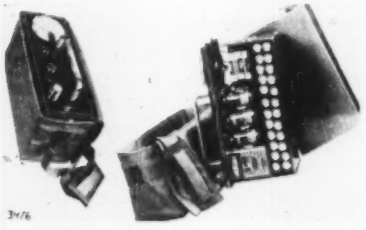


scaler with a high voltage range of 600 to 2000 v. to a reliable proportional counter. Counts alphas and both soft and hard betas, readily detects alpha activity in presence of betas and betas in presence of alphas. Input sensitivity adjustable from 0.5 mv. to 2.5 mv.—*Nuclear Measurements Corp.*, 2460 *N. Arlington Ave., Indianapolis* 18, *Ind.*

For more information circle **236** on inquiry card.

Beta-gamma Detector

New "Nucliometer" is a new type of multiple Geiger tube count rate meter for radioactivity detection where extreme sensitivity is required. It can be had with either 24 standard beta-gamma-sensitive Geiger tubes or with

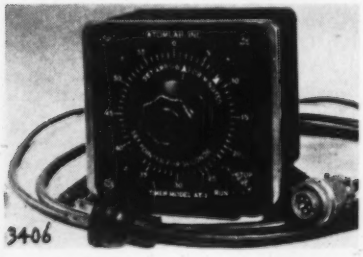


bismuth-coated-cathode Geiger tubes. It is provided with a compensator which to set count to zero in each area. Also selection of "time-constants" from 2 to 16 seconds.—*The Radiac Co., Inc.*, 489 *Fifth Ave., New York* 17, *N. Y.*

For more information circle **237** on inquiry card.

Timer for Scalers

New "Model AT 1 Dual Timer," for use in conjunction with scaling units calling for a relay type timer, can be



used either for predetermined or elapsed time operation. Range 2 sec. to 60 min. with 1-sec. increments.—*The Atomic Center for Instruments & Equipment, Inc.*, 489 *Fifth Avenue, New York* 17, *N. Y.*

For more information circle **238** on inquiry card.

BOURNS

sub-miniature

TRIMPOTS

TRADE MARK

PROVIDE THE ULTIMATE IN CIRCUIT TRIMMING

Simple screwdriver adjustment...

The TRIMPOT is a 25 turn, fully adjustable wire-wound potentiometer, designed and manufactured exclusively by BOURNS Laboratories. Electrical settings in increments of ¼ to ½% are securely maintained during vibration of 20 G's up to 2,000 cps or sustained acceleration of 100 G's. BOURNS' unique self-locking design eliminates cumbersome locknuts. Power rating is ¼ watt at 100° F. Standard resistance values from 250 ohms to 25,000 ohms are available for immediate delivery. Information on higher and lower resistances on request.

BOURNS TRIMPOTS are accepted as standard components by aircraft and missile manufacturers and major industrial corporations.

9 TRIMPOTS TAKE LESS SPACE THAN A 2¢ STAMP

Tiny cross-sectional size—only 1/4" x 5/16"—and rectangular shape save valuable panel space. Instruments are easy to mount individually or in stacked assemblies with two standard screws through the body eyelets.

BOURNS *also manufactures precision potentiometers to measure Linear Motion; Gage, Absolute, and Differential Pressure and Acceleration.*

BL

BOURNS LABORATORIES

6135 MAGNOLIA AVENUE · RIVERSIDE, CALIFORNIA

Technical Bulletin On Request, Dept. 22

© B L PATENTS PENDING

For more information circle **56** on inquiry card.

NO GUESSWORK

7 3 4

NO CHANCE FOR ERROR

with a
DIRECT READING

HYCON
DIGITAL
VTVM
MODEL 615

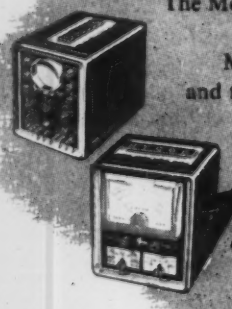
ILLUMINATED DECIMAL POINT AND POLARITY SIGN

$374.50

The Model 615 VTVM is a precision instrument — functional in design . . . professional in appearance. The direct-reading digital display eliminates most interpolation error — shortens costly "learning curve" in factory and assembly line inspection. Other features — never before offered in an instrument of comparable price — include 1% accuracy (DC and ohms), and *1 millivolt* sensitivity. Inspect the Model 615 at your Electronic Parts Jobber's. You'll agree the new standard is Hycon . . . "where accuracy counts."

• 12 RANGES: AC, DC, OHMS • AC FREQUENCY RESPONSE TO 250 MC (with auxiliary probes) • OVERLOAD PROTECTION • LIGHTWEIGHT, STURDY STEEL CASE • PROVISIONS FOR BENCH STACKING

The Model 615 VTVM is one of a matching set of precision test instruments, which includes the Model 617 Oscilloscope (designed for color TV) and the Model 614 Standard VTVM.



Service facilities in your area.

Hycon Mfg. Company

2961 EAST COLORADO STREET, PASADENA 8, CALIFORNIA

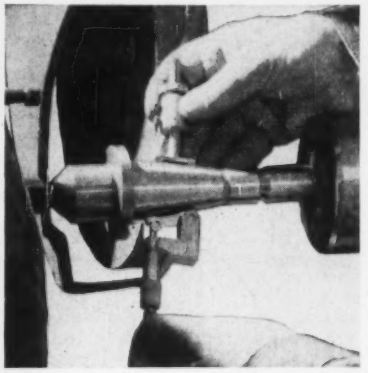
"Where Accuracy Counts"

For more information circle **57** on inquiry card.

DIMENSIONAL

Taper Micrometer

New "Taper-Mike" does away with time lost in removing workpiece from machine and setting up a sine bar,

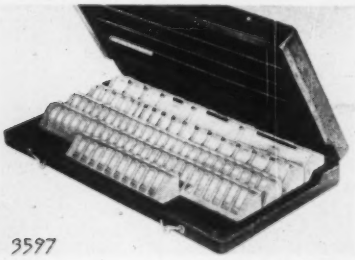


gage blocks, surface gage, etc.; it measures taper (to 0.0001 in.) while piece is still on machine. Scrap loss, too, is reduced: no more trying to get piece exactly on centers again for additional machining or grinding.—*Taper Micrometer Corp.*, 100 *Grove St., Worcester, Mass.*

For more information circle **239** on inquiry card.

Gage Block Set

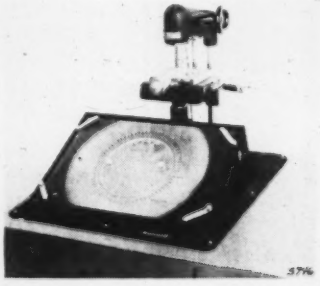
New "Laboratory Master" set of 82 gage blocks, said to be "the nearest approach to absolute dimensional perfection ever attained," are certified accurate within a microinch; are made of chrome carbide; will not accept oxidation, corrosion or microscopic films.—*Webber Gage Co.*, 12899 *Triskett Rd., Cleveland* 11, *Ohio.*



For more information circle **240** on inquiry card.

Optical Comparator

New model of "Wilder Micro-Projector" incorporates a larger range micrometer stage with 2-in. longitudi-

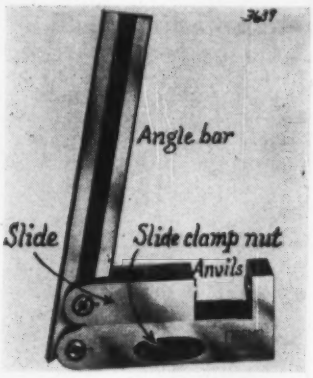


nal movement and 1½-in. cross movement; micrometer drums graduated directly in 0.0001-in. without vernier. In each direction, 1 in. is by the micrometers, remainder by gage blocks. —*George Scherr Optical Tools Inc., 200 Lafayette Street, New York 12, N. Y.*

For more information circle **241** on inquiry card.

Angle Gage

New "Gemo Bevelgauge," for making and checking angular setups to 1 minute of arc, features angle bar setting determined by position of slide



along base; and slide position governed by gage blocks placed between facing anvils. A standard 37-piece set of gage blocks provides for settings from 0 deg. to 180 deg. with respect to bottom of base, in increments of 1 minute of arc (0.017 deg.).—*Cleveland Instrument Co., 735 Carnegie Ave., Cleveland 15, Ohio.*

For more information circle **242** on inquiry card.

Optical Straightedge

New small model of "Huet Optical Straightedge" utilizes a beam of light, interrupted by reticle of a "feeler"

microscope, to measures deviations as small as 0.000,025 in. on flat surfaces up to 20 in. long. It was previously available only in 5-ft. or 10-ft. lengths; has applications in checking and correcting surface deviations in machine-tool tables, surface plates, cylinders, and other flat surfaces.—*F. T. Griswold Mfg. Co., 305 W. Lancaster Ave., Wayne, Pa.*

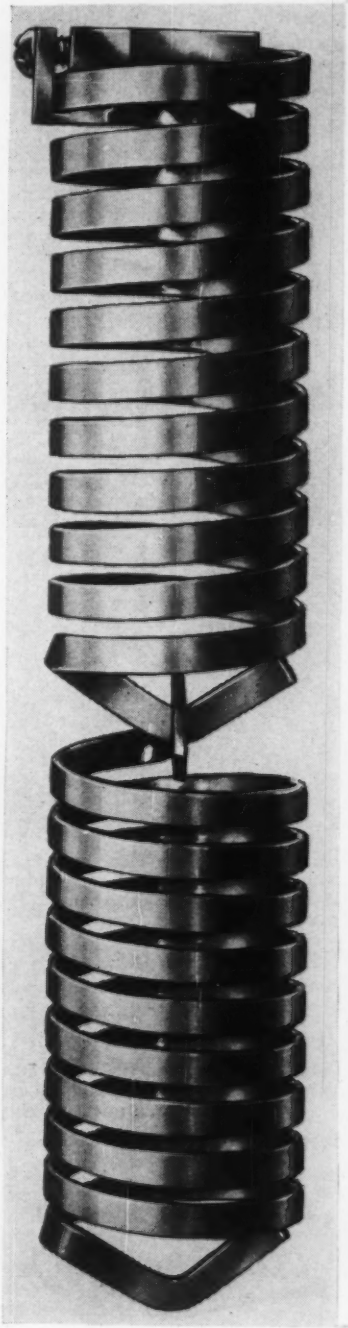
For more information circle **243** on inquiry card.

Granite Surface Plates

New "Clovis Black Granite" surface plates are finished by a special rotary honing process; pureness, grain, and

PRECISION TWIN EXTENSION SPRING

Available in practically all sizes and capacities



CHATILLON ISO-ELASTIC* makes this THE WORLD'S MOST ACCURATE SPRING

This type of Chatillon Iso-Elastic Twin Extension Spring is *used by every leading manufacturer of computing scales in the world.* Reason:—because it is *accurate to 1 part in 2,000!*

This extreme accuracy has induced companies like General Electric, Bendix, Pitney-Bowes, Sperry and many others who make precision instruments, to incorporate Chatillon Iso-Elastic springs into their designs.

The hysteresis error of this remarkable spring is less than .05% of deflection. Drift does not exceed .02% of deflection in 5 minutes. Combine these characteristics with temperature compensation and you have what is truly a *precision* spring in every sense of the word. Chatillon makes Spiral, Torsion, Compression and Form Springs of Iso-Elastic material, as well as springs of all conventional alloys.

We can help make your product better. Let Chatillon's Spring Division assist you. Write for engineering bulletins today.

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Chatillon's exclusive temperature-compensated spring material. U.S.A. Pat. No. 2174171.

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JOHN CHATILLON & SONS
85 Cliff Street, New York, N. Y.

For more information circle **58** on inquiry card.

New SCAM

HI-LO ALARM SYSTEM

- **up to 50% lower cost!**
- **completely interchangeable!**

Where ever your problem is one of monitoring Hi-Lo situations, here is the new low cost answer! The new Scam Hi-Lo abnormal alarm system fills a long felt need for an annunciator alarm that provides the conventional Hi-Lo sequence indication yet is in a lower price range than any heretofore available. The new Scam ACS Hi-Lo alarm is completely interchangeable in the same cabinet with standard Scam annunciators and is available with two types of light boxes —back lighted main plate type and dual bulls-eye type. They are available at 30 to 50% less cost than similar Hi-Lo systems yet have all the many Scam advantages including provisions for "locking in" momentary field signals.

Get all the facts—send this coupon!

Fill in and send this coupon to get complete literature on the new Scam Hi-Lo abnormal alarm system.

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Chicago 18, Illinois

Send me full information on the Scam Hi-Lo abnormal alarm system.

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For more information circle **59** on inquiry card.

density rated Class A by National Bureau of Standards; 24 standard sizes, from 9x12x3 in. to 72x144x16 in.; without ledges or with two to four ledges; eight standard accuracies.—*The Challenge Machinery Co., Grand Haven, Mich.*

For more information circle **244** on inquiry card.

Granite Surface Plates

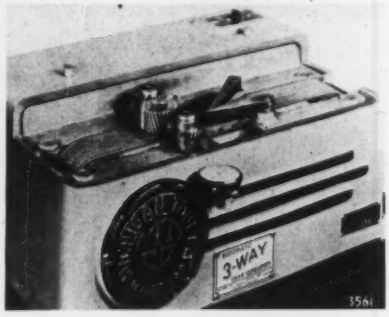
New granite surface plates are available as large as 72 x 144 in., in one solid piece. All are now mounted on special resilient neoprene vibration-damping mounting pads, which replace former leather or belting pads. Black diabase is said to have "the lowest absorption factor of all natural stone, in addition to being the densest and heaviest of all granite used for plates." Over-all accuracies to 0.00005 in.—*Lawley Granite Surface Plate Co., 2000 Wyoming Ave., Wyoming, Penna.*

For more information circle **245** on inquiry card.

MACHINE AUTOMATION

Gear Classifier

New conveyor-type "3-Way Gear Classifier" automatically separates gears into acceptable, salvageable, and

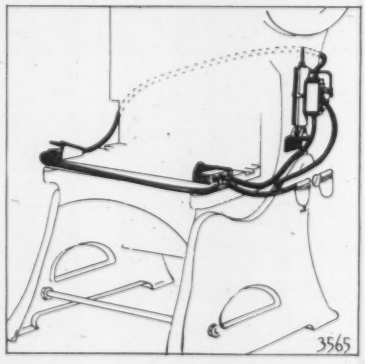


non-salvageable categories, based on any one or a combination of: undersize, oversize, correct size, eccentricity, and plus or minus helix angle.—*Michigan Tool Co., 7171 E. McNichols Road, Detroit, Mich.*

For more information circle **246** on inquiry card.

Power Machine Control

New "PMC" packaged pneumatic control for power presses, brakes, shears and other machines utilizing



mechanical clutches minimizes operator fatigue and maximizes operator protection on hazardous machinery. It operates from shop air line and its pneumatic circuit requires that both operating valves be pressed before action takes place. Action is non-repeat. Unit is available in either 2-in. or 3-in. cylinder bores, any desired stroke length.—*Modernair Corp., 400 Preda St., San Leandro, Calif.*

For more information circle **247** on inquiry card.

MECHANICAL TESTING

Fatigue-testing Machine

New "SF-100-U" Sonntag universal fatigue testing machine of 100,000-lb. capacity will have a table 6 ft. wide and nearly 12 ft. long; testing speed 1500 cycles per minute; ½-in. maximum movement of vertically reciprocating 14-in. by 14-in. platen; controls and contactors in separate cabinets. Deliveries in about a year.—*Baldwin-Lima-Hamilton Corp., Philadelphia 42, Pa.*

For more information circle **248** on inquiry card.

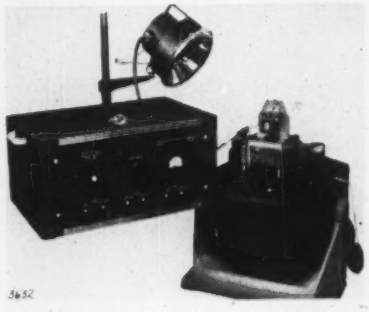
Vibration-test Shaker

New "B88" trunnion-mounted electrodynamic shaker, expressly designed for vibration testing aircraft structures, etc., has a rated force output of 100 lbs. and a total stroke of 3 in.; may be operated vertically, horizontally or at oblique angles. Frequency stability is exceptionally high: 0.5 percent. Among features: individual shaker force output adjustment and provision for in-phase or out-of-phase operation.—*The Calidyne Co., 120 Cross St., Winchester, Mass.*

For more information circle **249** on inquiry card.

Strobe Synchronizer

New "Model 102 Slip-Sync Frequency Modifier" automatically synchronizes stroboscopic lights with repetitive motion. In vibration testing



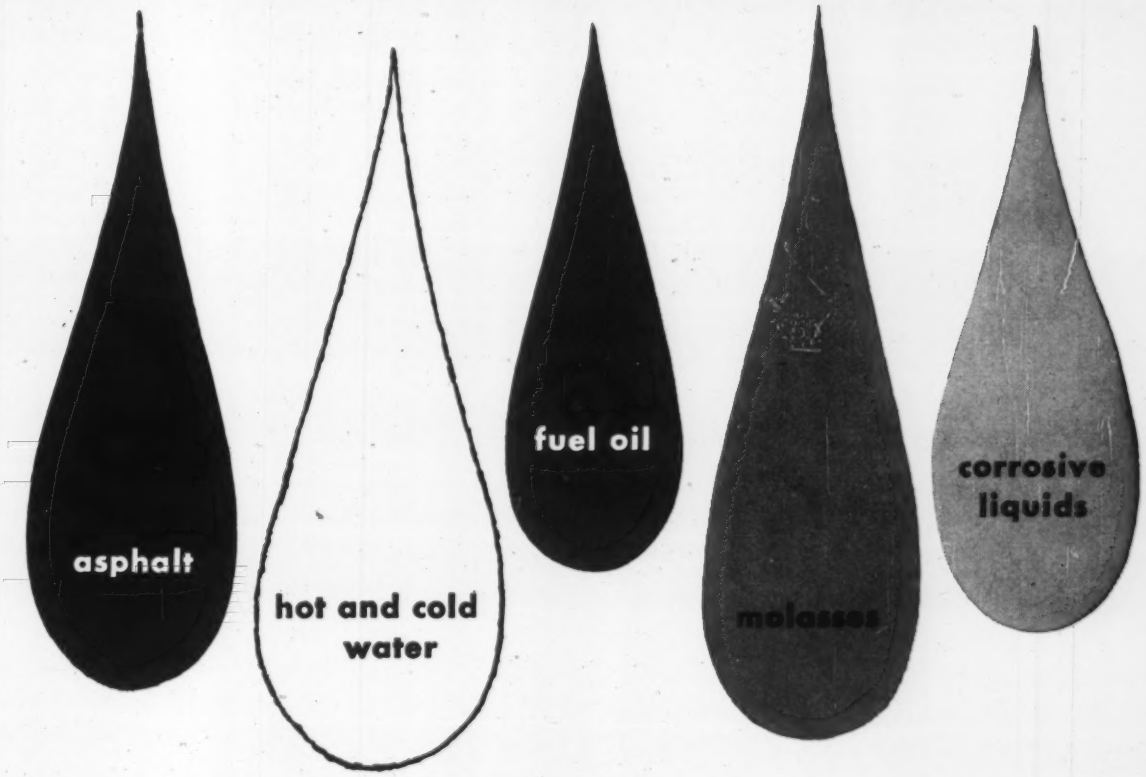
it permits observation of shaker-produced vibrations in apparent slow-motion or fixed at any desired cyclic position. Operates over input range 15 to 7500 cps. and 50:1 voltage ratio automatically.—*Chadwick-Helmuth Co., P. O. Box 321, Monrovia, Calif.*

For more information circle **250** on inquiry card.

Climatic Test Chamber for Wire and Cable

New climatic test chamber for temperature tests of wire and cable is equipped with mandrels from 1/16 in.

viscosities unlimited



HAYS VERIFLOW METER AND HAYS ELECTRONIC VERITROL

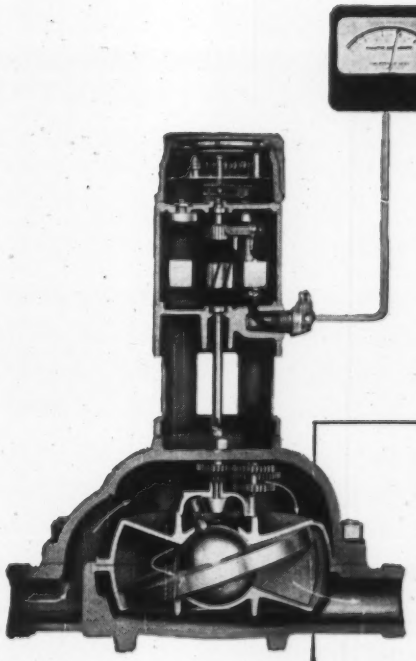
indicate and control liquid flow

Now virtually all fluids can be precisely measured and accurately controlled—*from a remote position.*

Hays VERIFLOW meter accurately measures, indicates, and totals the flow of corrosive and hard-to-meter liquids without using weigh tanks, orifice plates, or gage sticks.

With the Hays VERITROL you simply set a knob at the rate of flow desired . . . then, the VERITROL controls the flow of liquid at that set-rate.

Send for a complete description of Hays Veriflow Meter and Veritrol, Pub. No. 53-766-38.



for corrosive liquids

Acetic Acid, Aluminum Potassium Sulphate, Ammonia, Calcium Compounds, Carbolic Acid, Formaldehyde, Fruit and Vegetable Juices, Hydrogen Peroxide, Phosphoric Acid, Potassium Hydroxide, Sodium Compounds, Sulphuric Acid (concentrated), Stearic Acid, and many others.

Automatic Combustion Control
Boiler Panels • Hays-Penn Flowmeters
Veriflow Meters and Veritrol
Gas Analyzers • Draft Gages
Combustion Test Sets • CO_2 Recorders
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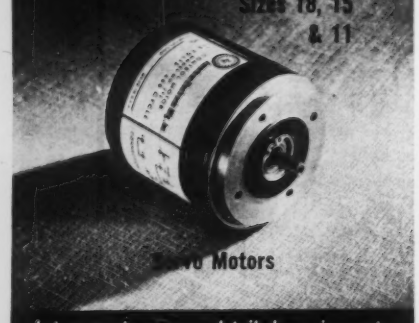
For more information circle 60 on inquiry card.

RELIABLE AND STABLE PERFORMANCE

A.C. servo and computer components

Brushless Induction Potentiometers



Let us quote on your detailed requirements.

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Application Engineering Offices in Principal Cities

For more information circle **61** on inquiry card.

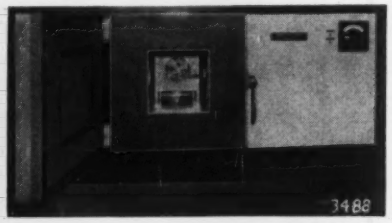
NEW INSTRUMENTS

to 18 in. with externally mounted turning devices and reduction gears. Temperature can be automatically cycled between 300 and –100 F., or held at fixed points within this range. Tests comply with Signal Corps, Air Force or CAA requirements. Instrumentation can be varied to meet user requirements.—*Conrad Inc., 183 Jefferson Ave., Holland, Mich.*

For more information circle **251** on inquiry card.

Temperature Test Chamber

New self-contained table-model low-temperature test chamber produces temperatures to –100 F. and will dissipate 1000 Btu/hr. at –80 F.; employs cascade system of refrigeration



with F22 in first stage and F13 in second. Heating (to 212 F.) is accomplished by non-glowing low-surface-temperature heaters. Automatic controls stop and start refrigeration and heating equipment to maintain set temperatures within 2 F. degrees.—*Tenney Engineering, Inc., 1090 Springfield Rd., Union, N. J.*

For more information circle **252** on inquiry card.

Chilling Machine

New low-temperature chilling machine has 36x42x36-in. chamber providing 27 cu. ft. of usable space. Adjustable temperature control from –70 to –150 F. Thermal capacity 8000 Btu/hr. at –120 F.—*Cincinnati Sub-Zero Products, 3930 Reading Rd., Cincinnati 29, Ohio.*

For more information circle **253** on inquiry card.

Torque Meter

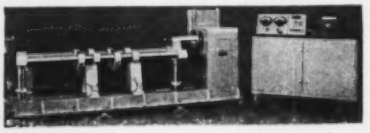
New "Torque Watch" reads torque on a linear "watch face"; weighs 7

ozs.; has chuck for shafts up to ¼ in. "Model 6000-1" 0.010 to 1.2 oz.-in.; "Model 6000-2" 1.0 to 20 oz.-in.—*Waters Mfg. Inc., 4 Gordon St., Waltham 54, Mass.*

For more information circle **254** on inquiry card.

Remote Control Balancing Machine

New static-dynamic balancing machine can have all controls and unbalance indicators located at any distance from body of machine. Voltage take-offs are provided so that a per-

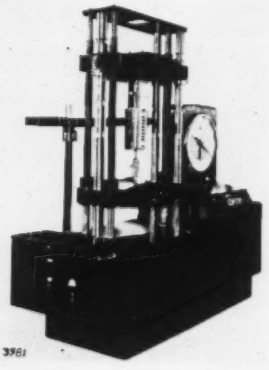


manent record of the unbalance readings can be made automatically on special electric typewriters. Operation is reduced to push-button simplicity.—*Tinius Olsen Testing Machine Co., 4058 Easton Road, Willow Grove, Pa.*

For more information circle **255** on inquiry card.

Testing Machine for High-temperature Work

New universal testing machine can utilize electric furnaces producing temperatures to 1750 F.; permits installation of multiple furnaces for produc-

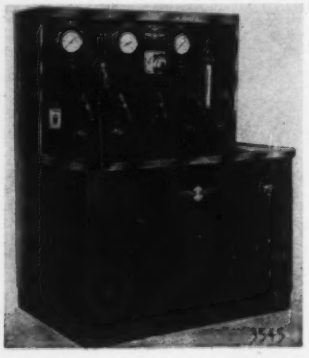


tion testing; maintains constant rate of strain at any speed setting.—*Riehle Testing Machines Div., American Machine and Metals, Inc., East Moline, Ill.*

For more information circle **256** on inquiry card.

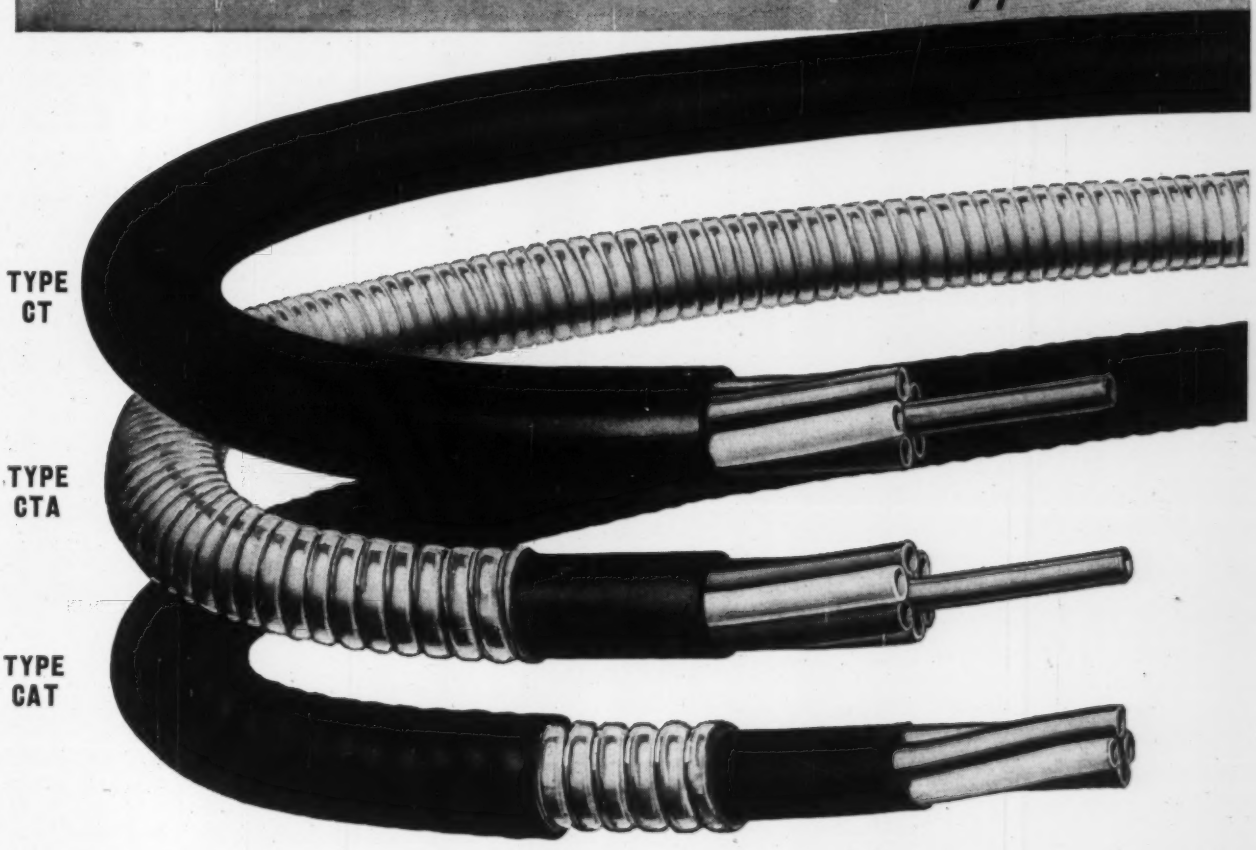
Hydraulic Tester

New "Model JK-100 Stationary Hydraulic Test Machine" determines performance and operating characteristics of aircraft or industrial hydraulic components at pressures up to 3000 psi. and flows to 6 gpm.; features automatic temperature control of oil,



CRESCENT ARMORED MULTITUBE

In 3 Corrosion Resistant Types



For Pneumatic and Hydraulic Instrument Controls

TYPE CT—In damp or corrosive locations where a moderate degree of mechanical protection to the tube is required, as in troughs or attached to building surfaces or supporting means, the construction shown in top view is recommended. It employs a tough corrosion-resistant thermoplastic sheath, resistant to water, acids, alkalies, oils, most chemicals, and is flame-retardant.

TYPE CTA—Where maximum mechanical protection is desired during or after installation, such as direct burial in concrete and pulling into conduit, an interlocked galvanized steel armor over the thermoplastic sheath, as shown in middle construction above, is recommended.

TYPE CAT—For maximum protection against corrosion and mechanical injury to the tubing, the thermoplastic sheath is applied over the flexible steel armor as shown in the bottom construction illustrated above.

These forms also provide the other advantages possessed by CRESCENT ARMORED MULTITUBE which include permanence, lower over-all cost and ease of installation.

CRESCENT ARMORED MULTITUBE consists of long length tubes twisted together to permit bending without distortion. In each layer one tube is a bright blue color, affording a fast means of identification from both ends.

Available in long runs up to 1000 feet and up to 19 tubes of copper, aluminum or polyethylene tubing in size ¼" O.D. This product is licensed under U.S. Patent 2,578,280.

Send for bulletin giving complete information and engineering data.

CRESCENT INSULATED WIRE & CABLE CO.

OLDEN & TAYLOR AVES., TRENTON, N. J.

For more information circle **62** on inquiry card.

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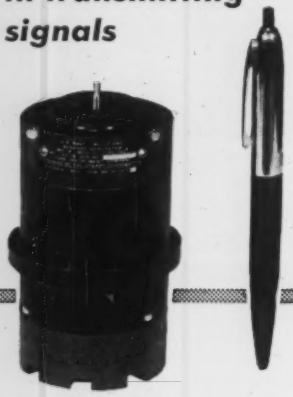
SYNCHROS
from FORD INSTRUMENT
for
extreme accuracy
in transmitting
signals



STANDARD TELESYN SYNCHROS
are available from Ford Instrument in

Size 1 Size 3
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A pioneer in the field of synchronous transmission, Ford Instrument produces synchros of proven precision accuracy.

- Available to meet Mil specs
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- For torque transmission and voltage indication

FREE a fully illustrated technical data bulletin gives characteristics and specifications. Please address Dept. IA.

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Ford Instrument's standard lines

Rate Generators

Differentials

Servo Motors

Telesyn Resolvers

Integrators

Telesyn Synchros

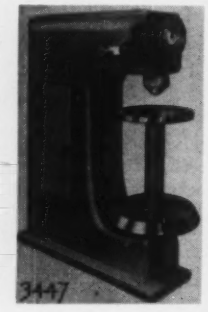
For more information circle **63** on inquiry card.

NEW INSTRUMENTS

manual flow control, Rotameter flow-rate indicator and precision pressure gages.—*Greer Hydraulics, Inc., New York International Airport, Jamaica 30, N. Y.*

For more information circle **257** on inquiry card.

Universal Hardness Tester

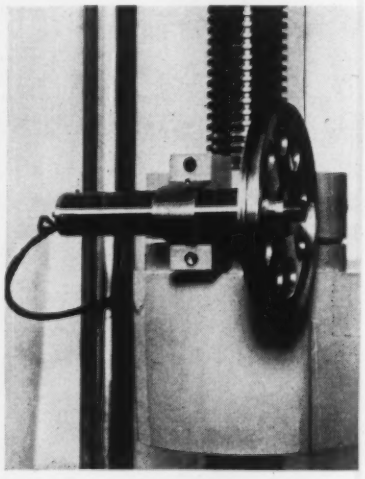


New German-made hardness tester permits making three tests. For Rockwell tests it has standardized penetrators (diamond or ball) for direct reading of C or Rb scales. For Brinell tests up to about 400, a steel ball of known diameter and fixed load is applied. For Vickers, an advantage in employing new machine is that each load application yields the same hardness value, facilitating testing of extremely small and thin objects. A microscope is available for Brinell and Vickers tests. A set of test blocks controls accuracy of machine. Several specimen holders hold objects of various shapes.—*William J. Hacker & Co., Inc., 82 Beaver St., New York 5, N. Y.*

For more information circle **258** on inquiry card.

Extensometer for Extra-large Strains

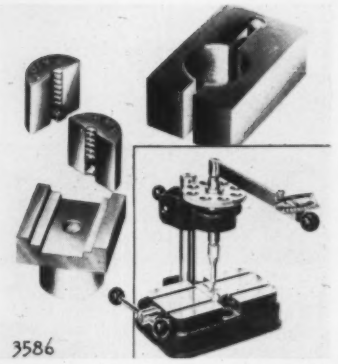
New "R-40" extensometer is a new type of strain-measuring instrument which, used in conjunction with maker's "Model 51 Electronic Recorder," has magnifications of 1, ½ and ¼ for recording motions of 10, 20 or 40 in.—*Tinius Olsen Testing Machine Co., 1235 Easton Rd., Willow Grove, Pa.*



For more information circle **259** on inquiry card.

Screw-testing Accessories

New set of split threaded collets, for use with Sturtevant Torque Testing Fixture for conducting torsional strength tests on screws, is complete

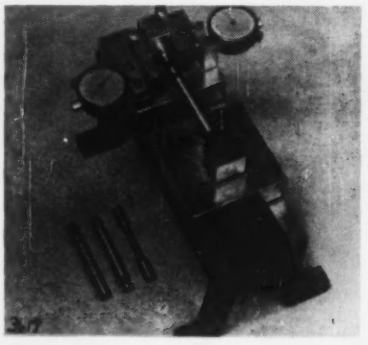


and all items are stocked for immediate delivery.—*Tools, Inc., 1733-37 No. 25th Ave., Melrose Park, Illinois.*

For more information circle **260** on inquiry card.

Specimen Tester

New inspection fixture for checking taper and concentricity of specimens



to be tested in "R. R. Moore High-speed Fatigue Testing Machine"—*Baldwin-Lima-Hamilton Corporation, Philadelphia 42, Pa.*

For more information circle **261** on inquiry card.

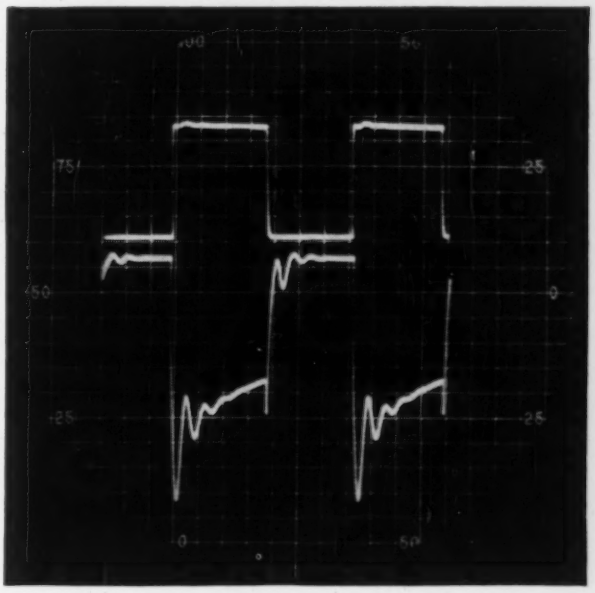
ELECTRICAL TESTING

Comparator Bridge

New "Model 50 Comparator Bridge" is for use as both a precision voltage source and a precision comparator of

voltages in range of minus 100 volts to plus 100 volts. As a secondary standard for calibration of instruments, accuracy to within 0.1 percent is readily obtainable. Sliding sensitivity on null indicator permits a coarse-to-fine null balance to be obtained

Observe and Measure...



Grid and plate waveforms of amplifier are displayed on common time base for accurate comparison. Grid waveform (top) observed on 100 millivolts full scale; plate waveform (bottom) observed on 100 volts full scale. Illuminated calibrated scale facilitates both visual observation and analysis of oscillogram.

...with the

DU MONT TYPE 322-A

Dual-Beam Cathode-ray Oscillograph

Observe and *accurately measure* two signals simultaneously on a single cathode-ray tube screen with the new Du Mont Type 322-A Cathode-ray Oscillograph.
In addition to the well-known advantages of observing the true relationship between two signals on the same screen, Du Mont offers built-in, accurate amplitude calibration of each of the two channels in the new Type 322-A. Push-button calibration, plus an illuminated scale permit rapid, convenient, wide-range voltage readings of signals.
The accuracy achieved in the new calibration system of the Type 322-A results from the use of the newly developed Du Mont Type 5AFP- tight tolerance cathode-ray tube.

FEATURES

- **High-accuracy, dual-beam Type 5AFP- Cathode-Ray Tube.**
- **Essentially two complete time-tested Type 304-A cathode-ray voltmeters in one cabinet. Ranges of measurement from 100 millivolts full scale to 1000 volts full scale.**
- **Expansion to 5 times full scale vertically and 6 times full scale horizontally.**
- **Sweep ranges from 2 cps to 30 KC compatible with frequency range of d.c. to 10% down at 100 KC.**
- **New concentric knobs for easy manipulation and accurate resetting.**
- **Illumination of special calibrated scale can be varied for viewing and photography.**

DU MONT
for Oscillography

WRITE FOR TECHNICAL INFORMATION

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For more information circle **64** on inquiry card.

MAINTAIN ACCURACY

high temperature ACCELEROMETER

Now, Pacific Scientific presents a unique new *high temperature* accelerometer, designed by Humphrey to give accurate, clear signals at temperatures from −65° to +550° F. —far in excess of former operating ranges! The rugged stainless steel and ceramic construction provides long life and allows precision tolerances for maintaining repeatability.

For the higher temperatures encountered in missile work, as well as for use in all types of aircraft where heat dissipation is a problem, this new unit provides the ideal answer!

SPECIFICATION DATA:

- **Environmental**—Temperature: −65° to +550° F. Shock: 60 G's in any direction without damage to the instrument.
- **Accuracy**—Within ½% to 2% depending upon G range and potentiometer resistance. (Including linearity, resolution and environmental conditions.)
- **Range**—Any range from −1 G +1 G and −50 G +50 G. Also available in asymmetrical ranges.
- **Resolution**—0.4% to 0.2% of full range. Potentiometer resistance can be furnished with any DC value between 300 and 20,000 ohms for all ranges.

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ARLINGTON, TEXAS, 111 East Main Street

For more information circle **65** on inquiry card.

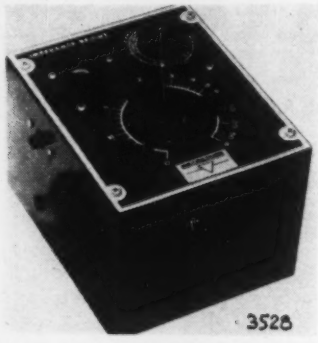
NEW INSTRUMENTS

within 0.5 microamp. without range switching. As a precision regulated power supply (0.05 percent regulation) Model 50 will supply up to 10 ma. at any voltage from minus 100 to plus 100 volts with a maximum internal impedance of 5,000 ohms.—*Donner Scientific Co.*, 2829 *7th St., Berkeley* 10, *Calif.*

For more information circle **262** on inquiry card.

R-C Bridge

New resistance-capacitance bridge increases speed and accuracy of making measurements on capacitors from 10 mmf. to 50 mf. and resistors from



10 ohms to 50 megohms; can be used also for making continuity measurements on circuits, coils and transformers.—*Deltron, Inc.*, 2905 *N. Leithgow St., Philadelphia, Pa.*

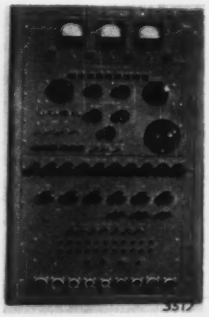
For more information circle **263** on inquiry card.

High-voltage Test Set

New "Model 437 D.C. Hypot" is now available as a standard caster-mounted model for plant and lab use; or rubber-tire-wheel-mounted, in enclosed steel case with shielded cable output leads for use in the field. Output voltage is 0-45 kv, read on a 4½ in. 3-range microammeter. Voltage doubler circuit with metallic diodes eliminates rectifier tubes and filament transformers. Diodes, filter capacitors, meter multipliers and transformer are completely oil-immersed for corona-free operation.—*Associated Research, Inc.*, 3758 *W. Belmont Ave., Chicago* 18, *Ill.*

For more information circle **264** on inquiry card.

Computer Tester



New flight data computer test unit, for production, hangar and flight line tests of airborne analog ballistics computer, gives a detailed test of every individual circuit and provides means for a complete alignment simulating all other units of radar fire control system. — *Cal-Tronics Corp.*, 11307 *Hindry Ave., Los Angeles* 45, *Calif.*

For more information circle **265** on inquiry card.

ELECTRICAL INSTRUMENTS

Electrometer

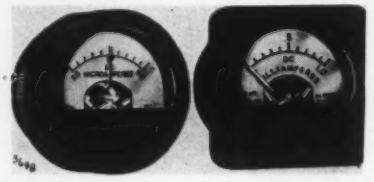
New "Cary Model 36 Vibrating Reed Electrometer" measures extremely small rapidly-varying cur-

rents, such as from analytical mass spectrometer; is said to be several times more sensitive than other amplifiers used for this purpose as well as more rugged. Other applications include rapid measurement of nuclear and x-radiations, electron emission phenomena, semi-conductor research, etc. Current range as usually supplied, 10^{-15} to 1.5 x 10^{-10} amp. Background noise in most sensitive range is equivalent to an input current of about 10^{-15} amp. rms. when source capacitance is less than 5 uf. Critically damped, 98.6 percent response in 0.1 sec. Higher sensitivity at slower response speeds. Output circuit will deliver a maximum of 1.5 ma. of either polarity to an indicator or recorder. —*Applied Physics Corp., Pasadena, Calif.*

For more information circle **266** on inquiry card.

Miniature Indicator

New "Model 150" 1½-in. sealed instrument, said to be "high precision," has 3 percent accuracy; is designed for easy one-hole mounting without

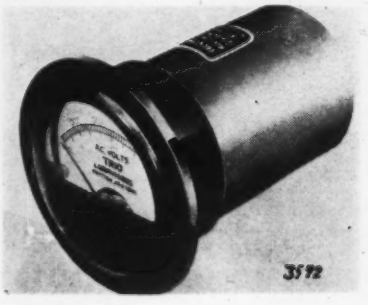


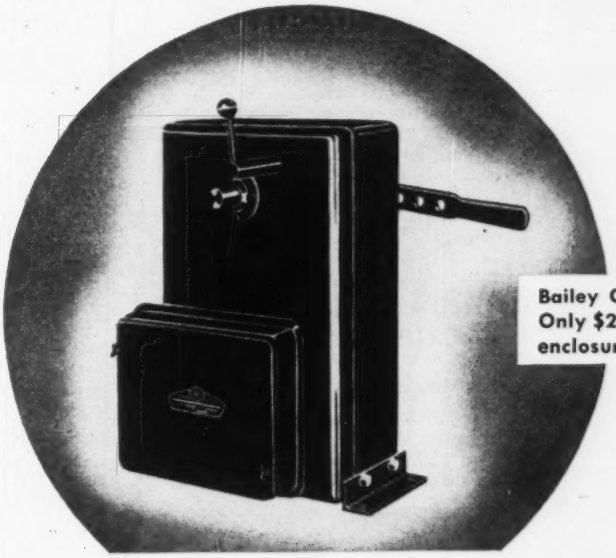
conventional mounting screws and related hardware. Knurled locknut with slots for wrench-tightening secures instrument to panel at rear. Damage to scale window will not destroy watertight seal to panel.—*DeJur-Amsco Corp.*, 45-01 *Northern Blvd., Long Island City* 1, *N. Y.*

For more information circle **267** on inquiry card.

Miniature A-c. VTVM

New ruggedized "Model B" can operate at temperatures over 160 F.; withstands shock; meets MIL-E-5400, MIL-M-10304, and MIL-T-945; fea-





Bailey Control Drive, Type AC44P Model 200. Only $210.00 F.O.B. Cleveland, complete with enclosure, positioning relay and hand operator.

Want Better Flow Characteristics from Your Regulating Devices?

This new, small, piston-operated Bailey Control Drive will improve the flow characteristics of butterfly valves, dampers, hydraulic couplings, feeders and similar regulating devices. Adjustment is simple; any desired relation between drive motion and pneumatic signal may be secured.

You can install this compact pneumatic drive power unit in any position on a column, pipe, or flat surface—and connect it to the regulating device with standard Bailey linkage, available from stock.

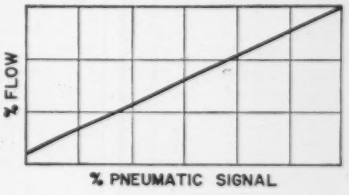
Speed (time required for full travel) is adjustable to suit your requirements. Bailey Control Drives operate on standard SAMA pneumatic signal ranges of 3 - 15 or 3 - 27 psig.

AVAILABLE FROM STOCK in 3 standard sizes

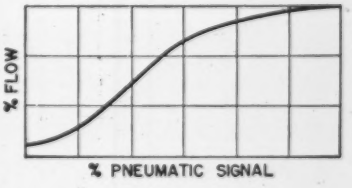
Type	Piston Dia. Inches	Piston Stroke Inches	Torque ft-lb	Max. Travel Degrees	Approx. Dimensions Inches
AC816	8	16	1500	90	13 x 27 x 51
AC68	6	8	400	90	13 x 19 x 34
AC44	4	4	75	75	10 x 11 x 19

P-28

The New Bailey Control Drive gives you THIS—



instead of THIS



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Controls for

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GAS ANALYSIS
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☐ I am interested in Bailey Control Linkage. Mail me Spec. CA942B.

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For more information circle **66** on inquiry card.

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EQUIPMENT

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Here are the latest releases in tubes, transformers, capacitors, test instruments and everything in electronics parts and equipment. See also the newest developments in Radio, TV and High Fidelity.

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For more information circle **67** on inquiry card.

The Simplified
PYRO
Optical Pyrometer

PYRO Optical Pyrometer is the only self-contained, direct reading, light-weight and dependable unit for quick and accurate high temperature measurements. Unique construction permits determinations even on MINUTE SPOTS, FAST MOVING OBJECTS or of the SMALLEST STREAMS. Special Foundry Type and Universal Triple Range have an additional Red Scale for direct readings of the true spout and pouring temperatures of molten iron, steel, monel, etc. when measured in the open. Stock ranges from 1400°F to 7500°F or in equivalent Centigrade calibrations. Ask for free Catalog No. 85 for complete details.

Free literature also available on PYRO Surface, Indicating, Radiation and Immersion Pyrometers.

PYROMETER INSTRUMENT COMPANY
New Plant & Laboratory
Bergenfield 34, New Jersey
Manufacturers of Pyro Optical, Radiation Immersion and Surface Pyrometers for over 25 years.

For more information circle **68** on inquiry card.

tures automatic scale selection. Extra terminals permit separate use of ammeter and of stable linear current-feedback amplifier. Full-wave rectifier bridge is available for use with both ammeter and amplifier.—*Trio Labs, P. O. Box* 143, *Wantagh, N. Y.*

For more information circle **268** on inquiry card.

ELECTRICAL-INSTRUMENT ACCESSORIES

Time-mark Generator

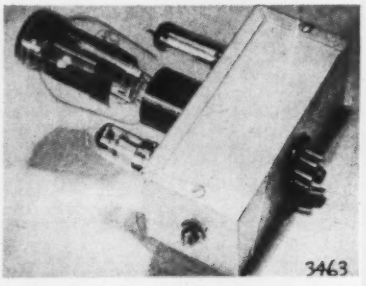
New "Type 181," designed primarily to calibrate CRO time bases, provides 1, 10, 100, 1000 and 10,000 usec. markers; 10-Mc. sine wave; output

amplitude approx. 3 volts; 1-Mc. crystal-stabilized oscillator accurate within 0.03 percent. Option: Type H-17 crystal in Type JKO-2 temperature-stabilized oven, giving stability of 2 parts per million.—*Tektronix, Inc., P. O. Box* 831, *Portland* 7, *Oregon*

For more information circle **269** on inquiry card.

Voltage Regulator

New "Regavolt" plug-in unit adapts an ordinary existing power supply to obtain accurately-regulated poten-

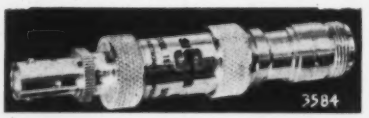


tials. Input 300 to 400 v.dc. unregulated; output 200 to 300 v.dc. adjustable; maximum output current 125 ma. regulated and 225 ma. unregulated.—*Mega Research, P.O. Box* 371, *Dover, N. J.*

For more information circle **270** on inquiry card.

Bolometer Mount

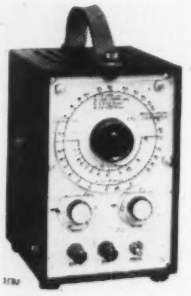
New "Model 157" bolometer mount for measuring relative RF power, particularly on low-duty-cycle RF pulses, may be used on pulse-modulated or unmodulated waves in a direct-reading d-c. bridge setup, or with an au-



dio transformer and voltmeter on modulated waves. It contains a special input terminating resistor, a fuse type bolometer and an output bypass condenser. Type N female input connector and BNC female output connector permit rapid connection into most test setups.—*Sierra Electronic Corp.*, 1050 *Brittan Ave., San Carlos* 2, *Calif.*

For more information circle **271** on inquiry card.

Audio Oscillator



New "Model 301 Utility Audio Oscillator" covers range from 12 cps. to 1 Mc. in six ranges. Distortion is less than 0.5 percent at lower frequencies; hum level is down –52 db from 1000 cps. to 1 Mc. and down –43 db from 60 to 1000 cps.—*Shasta Div., Beckman Instruments, Inc., P. O. Box* 296 *Station A, Richmond, Calif.*

For more information circle **272** on inquiry card.

Double Rectifier

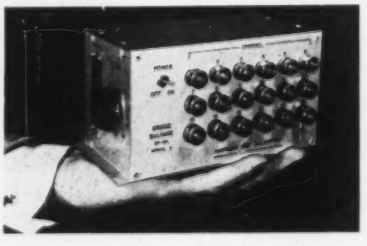
New dual channel rectifier combines two complete rectifiers, is so designed

that throw of switch cuts in second rectifier, thereby eliminating all down time. Can be had for any a-c. input and any required d-c. output 110-220 volts. Current rating 2 to 15 amps.—*Electronic Rectifier Co., Rochester, N. Y.*

For more information circle **273** on inquiry card.

Bridge Balance Unit

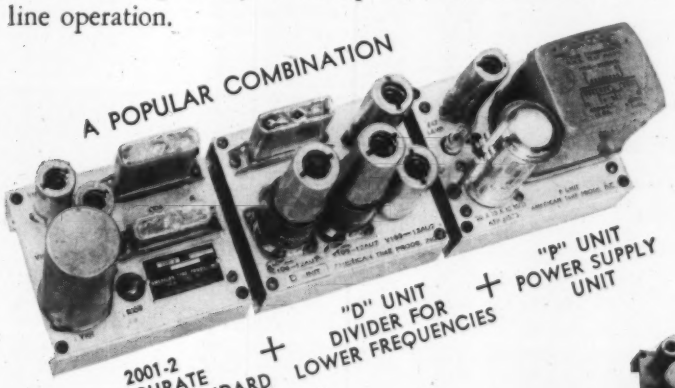
New "Model BP-18A Eighteen Channel Bridge Balance" has provisions for controlling electrical balance,



FREQUENCY STANDARDS

DESIGNED AS A *Modular system*

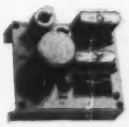
The Type 2001-2 series provides frequencies from 30 to 30,000 cycles with an accuracy of .001% (at room temperatures) in units suitable for integration with instruments of your own design — or for panel rack mounting with your own power sources — or for line operation.



WHICH WILL MEET YOUR
CUSTOM NEEDS
FROM A COMBINATION OF
STOCK UNITS

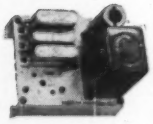
TYPICAL COMBINATIONS

2001-2	2001-2 + M
2001-2 + L	2001-2 + M + P
2001-2 + L + P	2001-2 + L + P + R
2001-2 + H	2001-2 + H + P + R
2001-2 + H + P	2001-2 + M + P + R



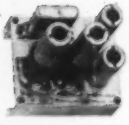
TYPE "2001-2"
FREQUENCY STANDARD
Frequencies, 200 to 3,000 cycles. Output, approximate sine wave at 5 volts.

ACCESSORY UNITS

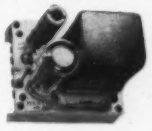


"L" UNIT.
DIVIDER, (MULTI-VIBRATOR TYPE)
Provides frequencies from 30 to 200, controlled by the 2001-2 unit.
Output, approx. 5V. Approx. sine wave.

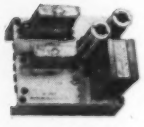
"M" UNIT
AMPLIFIER
Provides 2 watts at 6 and 110 volts.



"D" UNIT.
DIVIDER, (COUNTER TYPE)
Provides 40 to 200 cycles controlled by the 2001-2 unit. (fail safe)



"P" UNIT
POWER SUPPLY
Provides power for combinations of units illustrated, if other sources are inconvenient or not available.



"H" UNIT
MULTIPLIER
Provides frequencies from 3,000 to 30,000 cycles, controlled by the 2001-2 unit. Output, approximately 5 volts.

"R" UNIT
PANEL MOUNTING
Accommodates up to three units. Standard size is 8¾ inches high, 19 inches long.

For details, please request our "Type 2001-2" Booklet.

American Time Products, Inc.

580 Fifth Avenue ***New York 36, N. Y.***

OPERATING UNDER PATENTS OF WESTERN ELECTRIC COMPANY

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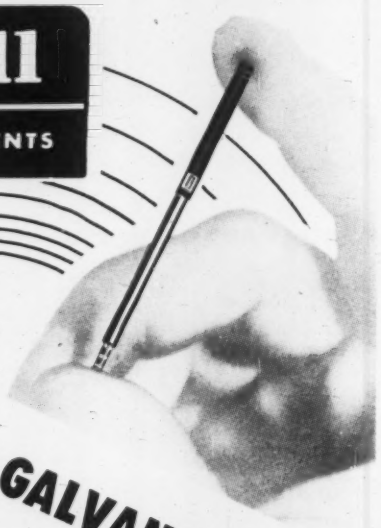


RECORDING OSCILLOGRAPHS and GALVANOMETERS

MODEL 708C

. . . give the ultimate in performance in all phases of oscillographic recording, particularly where high sensitivity, frequency response and resolution are important.

High sensitivity consistent with extended frequency range of galvanometers is achieved through special design characteristics backed by 20 years experience in the manufacture and design of recording instruments. Better resolution is obtained through increased record travel and writing speeds. The result is high amplitude recording of static and dynamic phenomena in the 0 to 3000 cps frequency range with extremely small input signals.

Write for complete information concerning our oscillographs, galvanometers and accessory bridge balance units and amplifier systems.

Heiland H HONEYWELL
A DIVISION OF MINNEAPOLIS-HONEYWELL
130 E. 5th Ave., Denver 3, Colo.

For more information circle **70** on inquiry card.

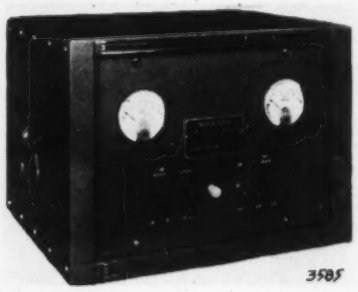
sensitivity and calibration of strain gages, accelerometers, pressure pickups, etc. It is said to be "the smallest and lightest unit of its kind known," and to be suited for use in aircraft and guided missiles as well as in laboratory work. Optional features include additional (or fewer) channels, continuously-variable or step sensitivity controls, and null indicator.—*American Helicopter, Div. Fairchild E&A Corp., 1800 Rosecrans Ave., Manhattan Beach, Calif.*

For more information circle **274** on inquiry card.

POWER SUPPLIES

Tubeless D-c. Supply

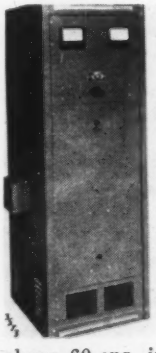
New "Nobatron Model MA 640," using magnetic amplifier principles, features highly advanced tubeless circuit. Input 105-125 vac, single phase,



60 cycle; output 4.5-7.7 vdc. adjustable; load range 0-40 amps.; regulation accuracy 1 percent for any combination of line and load conditions; recovery time 0.2 sec. under worst conditions.—*Sorensen & Co., Inc., 375 Fairfield Ave., Stamford, Conn.*

For more information circle **275** on inquiry card.

200-amp. D-c. Supply



New "Model MR-2432-200" tubeless magnetic amplifier regulated power supply, rated at 24-32 volts at 200 amps. continuously, has a regulation accuracy of 1 percent (a) from 0 to 200 amps, (b) for range of 24 to 32 v.dc., (c) for a-c. input range of 208/230/460 v.ac. plus or minus 10 percent; response time 0.2 sec. Unit is designed for three-phase 60-cps. input. Overload protection is in form of a magnetic starter with thermal overload also provided. —*Perkin Engineering Corp., 345 Kansas St., El Segundo, Calif.*

For more information circle **276** on inquiry card.

Computer Power Supplies

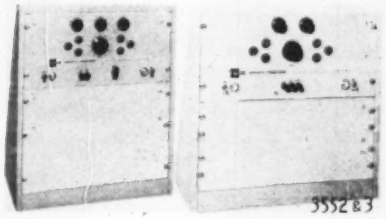
New regulated power supplies, specifically intended for digital computer application, are adaptable up to 25 kw. of power at voltage levels consistent with computer requirements;

are constructed with magnetic components and conservatively-rated selenium rectifiers. Accuracy 0.5 percent from 0.1 load to full load with 10 percent change in line voltage with 5 percent change in line frequency. Speed of response 0.17 sec. 0.1 load to full load. Can be provided for assembly in standard relay racks.—*Mag-Electric Products, Inc.*, 12822 *Yukon Ave., Hawthorne, Calif.*

For more information circle **277** on inquiry card.

D-c. Power Supplies

Two new "Absolute D-c. Power Supplies" feature continuous comparison of output voltage against standard



cell and consequent stability. "Model 200 D-2" has 20-ma. output variable from 100 to 2000 volts in 10-v. calibrated steps and voltage division between steps. "Model 3553" has 2-amp. output variable from 2 to 30 volts in 1-v. steps with voltage division between steps. Short-term stability of both is 50 parts per million per hour. —*Kalbfell Laboratories, Inc.*, 1090 *Morena Blvd., San Diego*, 10, *Calif.*

For more information circle **278** on inquiry card.

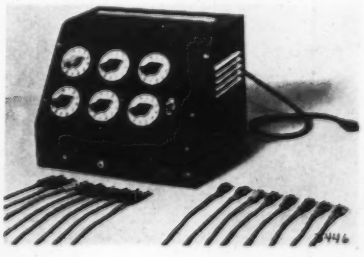
Regulated-voltage Supply

New "Model 2004A" features line regulation within 0.01 percent; output, zero to 1 ma.; six taps (10 to 500 v.dc.) accurate within 2 percent; also continuous variation from 5 to 500 v.dc. Polarity switch so that test voltage can be either positive or negative. Also zero-output switch permitting connections to be made while instrument is on and facilitating timing of measurements.—*Keithley Instruments*, 3868 *Carnegie Ave., Cleveland, Ohio.*

For more information circle **279** on inquiry card.

Power Supply for Electrosensitive Paper

New "Power Unit" provides current for use with electrically-responsive facsimile chart papers. Also, any



More Engineers on A-N and civilian projects are proving—

It pays to specify

AMPERITE

DELAY RELAYS

and

BALLAST REGULATORS

...they're finest ... *cost less!*

STANDARD

Thermostatic DELAY RELAYS

MOST COMPACT, HERMETICALLY SEALED

Provide delays ranging from 2 to 150 seconds.

- Actuated by a heater, they operate on A.C., D.C., or Pulsating Current.
- *Hermetically sealed.* Not affected by altitude, moisture, or other climate changes.
- Circuits: *SPST only* — normally open or normally closed.

MINIATURE

Amperite Thermostatic Delay Relays are compensated for ambient temperature changes from —55° to +70°C. Heaters consume approximately 2 W. and may be operated continuously. The units are *most compact, rugged, explosion-proof, long-lived,* and — *inexpensive!*

TYPES: Standard Radio Octal, and 9-Pin Miniature.

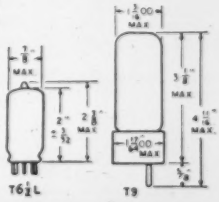
PROBLEM? Send for Bulletin No. TR-81

Also — a new line of **Amperite Differential Relays** — may be used for *automatic overload, over-voltage, under-voltage* or *under-current protection.*

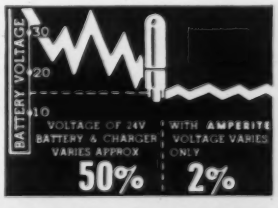
T9 BULB

BALLAST REGULATORS

- Amperite Regulators are designed to keep the current in a circuit ***automatically regulated*** at a definite value (for example, 0.5 amp).
- For currents of 60 ma. to 5 amps. *Operates on A.C., D.C., Pulsating Current.*
- Hermetically sealed, light, compact, and most inexpensive.



Amperite Regulators are the simplest, most effective method for obtaining ***automatic regulation*** of current or voltage. ***Hermetically sealed,*** they are not affected by changes in altitude, ambient temperature (—55° to +90°C), or humidity. Rugged; no moving parts; changed as easily as a radio tube.



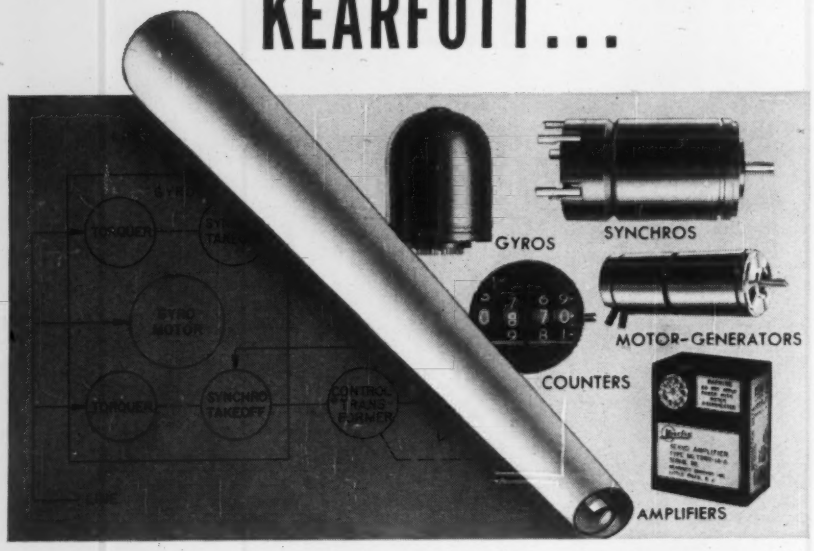
Write for 4-page Technical Bulletin No. AB-51

AMPERITE CO. Inc., 561 Broadway, New York 12, N. Y.

In Canada: Atlas Radio Corp., Ltd., 560 King St. W., Toronto 2B

For more information circle **71** on inquiry card.

KEARFOTT...



from problem through production

Engineering ability and production facilities are as important to you as the characteristics of the components you select. After components are approved, you are dependent upon your supplier . . . dependent upon him for engineering assistance . . . dependent upon his ability to produce quality products in the required quantities.

Many of the servo motors, synchros, gyros and systems in use today had their inception on the drafting boards of Kearfott's engineers. This is proof of Kearfott's engineering ability. Kearfott offers complete engineering service before, during and after the purchase of a component.

A modern building, over 430,000 square feet of floor space, equipped with the latest in precision machinery, manned by 3,000 highly skilled specialists, is your assurance of Kearfott's ability to produce.

Yes, Kearfott is a dependable source of supply. If you have a design problem or require a special or standard component, contact Kearfott.

KEARFOTT COMPONENTS INCLUDE:

Gyros, Servo Motors, Synchros, Servo and Magnetic Amplifiers, Tachometer Generators, Hermetic Rotary Seals, Aircraft Navigational Systems, and other high accuracy mechanical, electrical and electronic components.

Send for bulletin giving data of components of interest to you.

Kearfott

A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

KEARFOTT COMPANY, INC., LITTLE FALLS, N. J.

Sales and Engineering Offices: 1378 Main Avenue, Clifton, N. J.
Midwest Office: 188 W. Randolph Street, Chicago, Ill. South Central Office: 6115 Denton Drive, Dallas, Texas
West Coast Office: 253 N. Vinedo Avenue, Pasadena, Calif.

For more information circle **72** on inquiry card.

ink-writing instrument and many indicating instruments can be converted easily. Six independent grid-controlled d-c. circuits. Each circuit has one distinct color on its control knob, jack, plug, and test clip.—*Gorrell & Gorrell, Haworth, N. J.*

For more information circle **280** on inquiry card.

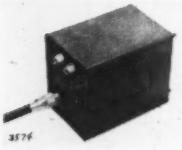
Constant-current Supply

New "Model CC-503-B" is first in a series of production-manufactured constant-current d-c. power supplies. Output from zero to 500 ma. in five steps with vernier control of 100 ma. between steps. Voltage across load 100 to 250, depending on load resistance. Regulation is 0.3 percent for 10-v. line variation, 0.03 percent for load change. Standard rack panel mounting.—*Dressen-Barnes Corp., 250 N. Vinedo Ave., Pasadena 8, Calif.*

For more information circle **281** on inquiry card.

H-v. Power Supplies

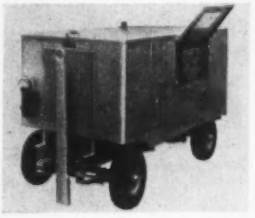
New line of power packs is for airborne use. Input frequency is 400 cps.; output range from 1 to 25 kvdc. is covered by six models. Temperature range minus 60 C. to 85 C. Units can be operated in any position. Unique feature is new output terminal construction which is small, but provides adequate flashover for operation at 50,000 feet.—*Plastic Capacitors, Inc., 2511 W. Moffat St., Chicago 47, Ill.*



For more information circle **282** on inquiry card.

Ground Power Supply

New 400-cps. ground power supply is weatherproof and completely winterized. Radio interference is suppressed. Both alternator and d-c. generator are driven by an industrial gas



engine rated for continuous duty. All engine controls are included as well as instruments, circuit breaker and protective relays.—*Electroflow Div., American Electronics Inc., 2112 Chico Ave., El Monte, Calif.*

For more information circle **283** on inquiry card.

Airborne Power Supply

New "Model MRP-15D-0.2 Stablvolt" tubeless magnetic amplifier regulated d-c. power supply, for airborne application, delivers plus and minus 15 v.dc. at 0.2 amp. for each channel, minus 15-v. channel slaved to plus 15-v. channel to provide 0.25 percent differential regulation for combined

changes in line voltage from 105 to 125 v., in line frequency from 380 to 420 cps., differential load changes of 10 percent and temperature from –55 C. to 71 C. Unit is self protecting from external overload and short circuits (no fuses required); hermetically sealed and conforms to MIL-T-27. Dimensions are 4-5/16 x 3-11/16 x 4½ in.—*Magnetic Research Corp., 200-202 Center St., El Segundo, Calif.*

For more information circle **284** on inquiry card.

D-c. Bias Supply

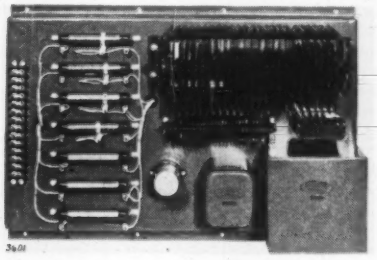
New "Model 703 Bias Box" is an accurately-adjustable source of fixed bias between 0 and 17 v.dc. produced from any radio or television receiver's 6.3-volt heater supply.—*Boland & Boyce, Inc., 236 Washington Avenue, Belleville 9, N. J.*

For more information circle **285** on inquiry card.

AMPLIFIERS

Magnetic Amplifiers

New "Model S-1446," for a 10-kva. 115-v. 400-cps. single-phase alternator, gives 1 percent voltage regulation from no-load to full-load, will withstand 150 percent overload; recovery



time 0.3 sec. Sealed; moisture- and fungus-resistant. ★ "Model S-1442" is for 115/208-v. 400-cps. 3-phase alternator; operates into high impedance field; 3-phase sensing.—*Acme Electronics, Inc., 2724 S. Peck Rd., Monrovia, Calif.*

For more information circle **286** on inquiry card.

Servo Amplifier

New "R6G16W1 Magnetic Servo Amplifier" can be used to operate any two-phase 60-cps. servomotor requiring up to 16 watts into control phase; can be supplied with a built-in magnetic, transistor, or vacuum-tube preamplifier. In all cases, power supply required is 115 v. 60 cps. single-phase. It is suited, without a preamplifier, for many medium-performance indicating and position type servomechanisms. With a simple preamplifier it may be employed in the most accurate and demanding type of control systems.—*Polytechnic Research & Development Co., Inc., 202 Tillary St., Brooklyn 1, N. Y.*

For more information circle **287** on inquiry card.

Servo Amplifier

New "R40G10W1" magnetic servo amplifier delivers up to 10 watts reversible phase a-c. output into control phase of MK7 and MK8 servo-

The New Hygrodial

AN IDEAL INSTRUMENT FOR CHECKING RELATIVE HUMIDITY AND TEMPERATURE

The new Hygrodial is the most up-to-date humidity indicator on the market. It is a precision, hair operated device calibrated to professional standards.

The humidity range is from 10% to 95% on an expanded, easy to read dial, graduated from 0% to 100%. The temperature range is from 0° F. to 110° F.

Air conditioning and refrigeration

Portable and precise, the Hygrodial is an ideal instrument for sales and service work in air conditioning and refrigeration. It is of invaluable aid in any industry or business that needs to know the relative humidity.

Write to Bendix*-Friez for further information about this accurate, low cost indicator.

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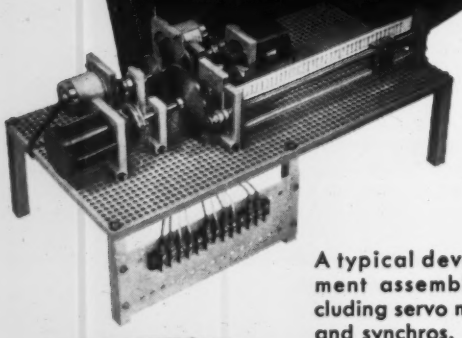
Bendix International Division, 205 E. 42nd St., New York 17, N. Y., U. S. A.

For more information circle **73** on inquiry card.

FAST...economical assembly of motors, gear trains, electro-mechanical computing and transmission devices with mechanical development apparatus

Servomechanisms, Inc., versatile Mechanical Development Apparatus is intended for numerous applications in the research, instrumentation, and servo control fields. Typical applications of these precision built components include analog computers, signal generators, process programmers . . . Assembly is made with standard tools . . . each component is designed for repeated use.

Foundation Boards and Legs
Mounting and Bearing Blocks
Stainless Steel Shafts and Gears
Limit stop, Couplings, Lead screws, Clutch, Dials, Cams, Switch



A typical development assembly including servo motors and synchros.

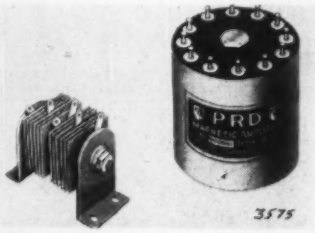
SERVOmechaNISMS INC.
PACKAGED FUNCTIONAL COMPONENTS

Write for Descriptive literature MDA-200

Components Division, 625 Main Street, Westbury, N.Y.

West Coast Division, 316 Washington Street, El Segundo, California

For more information circle **74** on inquiry card.



motors for reversible-phase a-c. or reversible-polarity d-c. input; features operation at high temperatures in control or servo systems where one-cycle response is mandatory. Can be supplied as illustrated or with a built-in magnetic, transistor, or vacuum-tube preamplifier. Supply required is 115 v. 400 cps. single phase.—*Polytechnic Research & Development Co., Inc.*, 202 *Tillary St., Brooklyn* 1, *N. Y.*

For more information circle **288** on inquiry card.

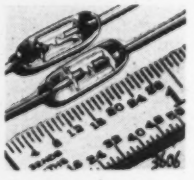
ELECTRICAL and ELECTRONIC COMPONENTS

Five-amp. Transistor

New "2N57 super power" transistor capable of delivering up to 5 amps. features unique structure which permits rapid flow of heat to outside of unit from which it can be conducted by various means, depending on application. Current gain is about 30 at collector currents up to 1 amp. Unit can operate with a maximum collector voltage up to 30 volts in a common emitter circuit, or up to 60 volts in a common base circuit.—*Minneapolis-Honeywell Regulator Co., Philadelphia* 44, *Pa.*

For more information circle **289** on inquiry card.

Germanium Diodes



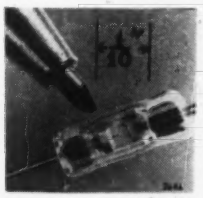
New "Types OA71, OA73 and IN87G" germanium diodes are "all glass envelope" types; feature unusual resistance to humidity and other environmental conditions. "IN87G" video detector offers high rectification efficiency with low loading on resonant circuits. "OA71" is a high-back resistance type for computer and general purpose applications. "OA73" video detector, intended for higher level IF signals where its greater back resistance eliminates peak sync clipping, has stability and high front-to-back ratio making it applicable for computer applications such as transistor clamps. —*Amperex Electronic Corp.*, 230 *Duffy Ave., Hicksville, L. I., N. Y.*

For more information circle **290** on inquiry card.

Gold Junction Diodes

New subminiature germanium diodes, employing a miniature gold junction, are described as "a true junction device, with exceptionally stable mechanical and electrical characteris-

ties." High forward conductance with high back resistance properties are said to make them particularly suitable for such applications as magnetic



amplifier circuits, clamps, d-c. restorers, and logical gates.—*Hughes Aircraft Co., Semiconductor Div., Florence Ave. at Teale St., Culver City, Calif.*

For more information circle **291** on inquiry card.

Variable Delay Lines

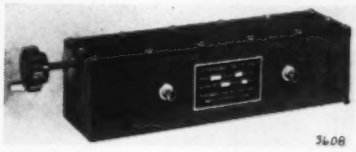
New "Model GVDL-1000-0-5" units provide continuously variable delays from 0 to 0.5 usec., feature light weight, small size (7½ in. long), fast rise time (0.075 usec. at full delay),

1000-ohm characteristic impedance, negligible attenuation, 5-Mc. bandwidth at full delay; and resolution of 0.0003.—*The Gudeman Co., of California, Inc., 9200 Exposition Blvd., Los Angeles 34, Calif.*

For more information circle **292** on inquiry card.

Variable Delay Line

New variable delay line features continuous variation of delay time by shaft rotation. Variation can be as

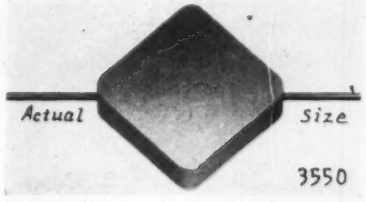


wide as 4 to 1 (e.g., from 10 to 40 usec.) with practical extremes being 2.5 to 5 usec. and 20 to 75 usec. Other features include high stability (short-time jitter non-existent).—*Andersen Laboratories, Inc., 39 Talcott Road, West Hartford, Conn.*

For more information circle **293** on inquiry card.

Miniature Toroid

New "Type EM-14P Postage Stamp Toroid Coil" consists of a subminiature molybdenum permalloy toroid



core with a winding having a residual hole as small as 1/16 in.; epoxy-encased. Available in any inductance up to 1 Hy. Useful frequency range 1500

Circle **75** on inquiry card. ⟶

THERE'S MORE FOR YOUR MONEY··IN PANALARM "50" ANNUNCIATOR SYSTEMS

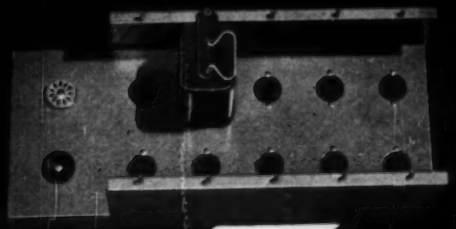
No annunciator system ever offered as much in value as PANALARM "50".

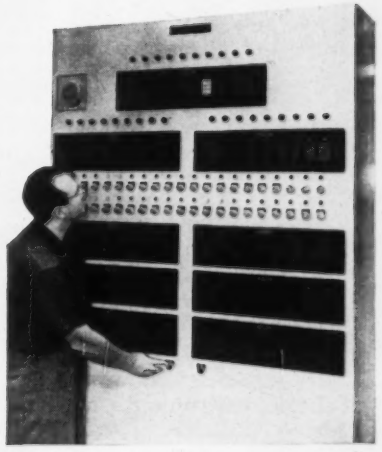
Examine for yourself every piece and component . . . consider the savings you realize through standardization and complete flexibility that only PANALARM "50" provides.

Then, evaluate *dependability*. Beyond all else, PANALARM "50" represents the greatest value in audio-visual alarm systems by its record of *dependable service* alone.

STANDARD CHASSIS

is interchangeable without re-wiring for all types of annunciator service: standard audio-visual; ringback; bullseyes or nameplates; trouble or running signals; lock-outs; or low drain operation.





PANALARM IS PROVEN!

In hundreds of plants—serving for many years—Panalarm Annunciators have demonstrated outstanding performance. They have won confidence for the very critical part they play in plant operation and safety.

PANALARM PLUG-IN UNITS

. . . *heart of the system* . . . incorporate finest telephone-type relays and special contact arrangements . . . assure sequential operation. Hermetically sealed suitable for Class I, Div. 2 locations.

SEND FOR COMPLETE MANUAL.
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PANALARM PRODUCTS, INC.
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PANALARM

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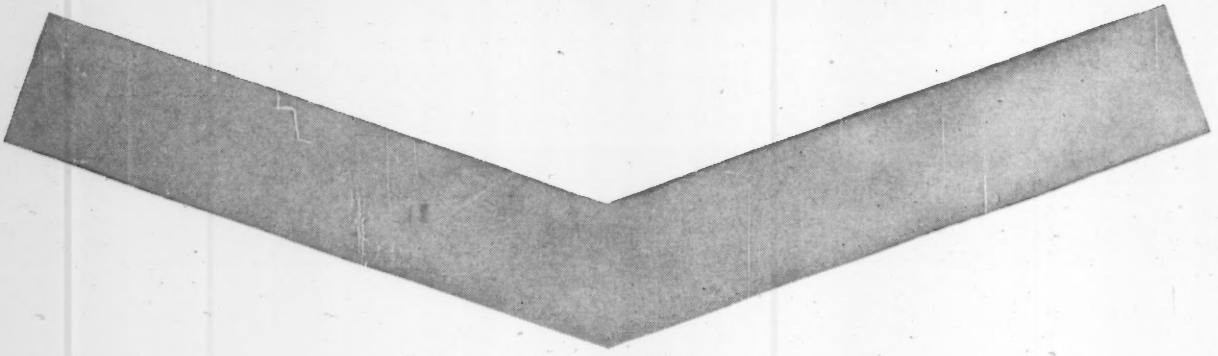
Only Brown flow meters offer you these profitable "*plus*" values



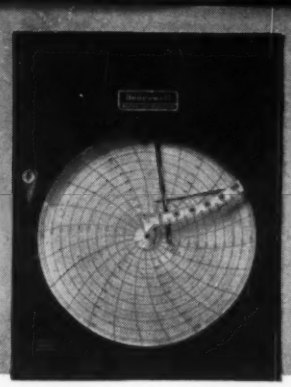
- ***16 different types*** of basic instrument systems . . . a flow meter for every fluid, every pressure, every operating requirement. *You're sure to find the most profitable meter for your specific application.*

- ***Nearby service facilities.*** There's a Honeywell service center as near to you as your phone. Service by factory-trained specialists is prompt, competent and economical. *You're sure to get maintenance and start-up service without delay.*

- ***27 years of experience*** in flow metering development and application work. *You're sure to get specialized engineering on your flow metering problem.*

- ***Nationwide field organization.*** Brown flow metering consultation is available from experts in more than 90 field offices, located near every major production center. *You're sure to have application engineering on hand where and when you need it.*

For more information circle **76** on inquiry card.

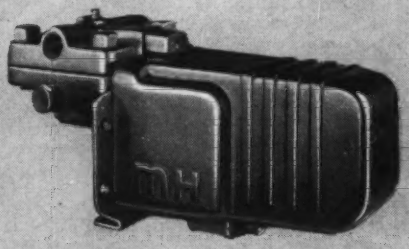


Linear scale meters—mechanical or electrical types, all control forms.

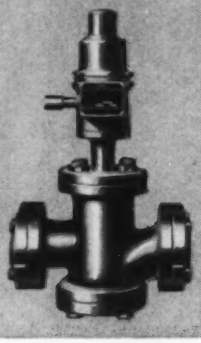
Square root scale meters—mechanical, or electrical or pneumatic transmission . . . all control forms.

Portable meters—versatility, for spot checks of flow values not continuously recorded.

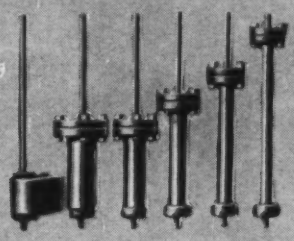
Low pressure meters—either electrical or mechanical type, for air or gas flow.



Differential Converter—mercury-less pneumatic flow transmitter with infinitely adjustable range.



Area Type Meters for measuring flow of viscous fluids . . . electrical transmission.



Interchangeable range tubes typify rangeability of all Brown flow meters.

NOTE:
Tel-O-Set miniature instruments and *ElectroniK* indicators, recorders and controllers are available for use with all flow transmitters.

a flow meter for every fluid...

every application (all available with electronic integration)

In performance, too, Brown flow meters provide you unsurpassed precision . . . reliability . . . convenience . . . with minimum maintenance requirements. In every way, you'll find it pays to select your flow meters from the one line that offers the most value.

Your nearby Honeywell sales engineer will be glad to discuss your specific flow application . . . and he's as near as your phone.

Minneapolis-Honeywell Regulator Co., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● **REFERENCE DATA: Write for new Catalog 2320, "Flow Meters, Indicating, Recording, Integrating, Controlling."**

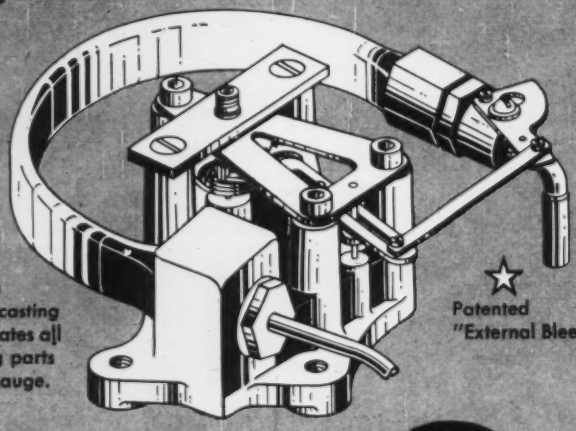
MINNEAPOLIS **Honeywell**
BROWN INSTRUMENTS
First in Controls

For more information circle **76** on inquiry card.

HEISE GAUGES

Permanent positive accuracy of alignment guaranteed by integral construction.

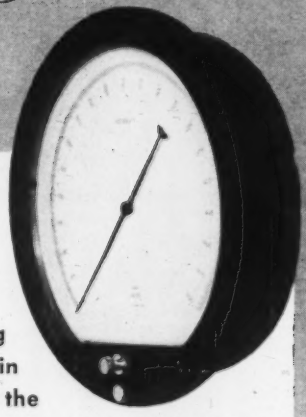
Weldless heat treated Bourdon tube maintains precise calibration.



Massive Bronze casting coordinates all working parts of the gauge.

Patented "External Bleeder"

Dial individually engraved with reference to the pressure gradient of its gauge mechanism.



ACCURACY

The standard of excellence maintained by Heise qualifies this instrument for the most exacting requirements. Designed to maintain permanently its inherent precision, the Heise gauge is often used in place of the dead weight tester in checking other instruments. Consistently accurate performance as a calibration reference has established its recognition as THE STANDARD OF THE WORLD.

SPECIALIZATION AND EFFICIENCY

Heise Laboratories have always specialized in the design and production of high precision pressure gauges. The highest standards of quality control protect the manufacture and assembly of each component and the permanent calibration of the finished instrument.

Efficiency in the production of one type instrument, precision pressure gauges, has made it possible to maintain a prompt delivery schedule.

DELIVERY WITHIN 30 DAYS.

Pressure Range 15 to 20,000 P.S.I.
Dial Sizes 8½"—12"—16"
Prices from $151.60

Catalog on Request

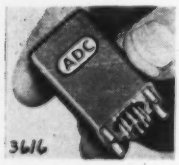
HEISE BOURDON TUBE COMPANY, INC.
BROOK ROAD, NEWTOWN, CONNECTICUT, U.S.A.

For more information circle **77** on inquiry card.

cps. to 150 kc. depending on inductance value. Temperature range –55 C. to 125 C.—*Hycor Co., Inc.*, 11423 *Vanowen St., North Hollywood, Calif.*

For more information circle **294** on inquiry card.

Miniature Transformers



New miniature hermetically-sealed transformers and chokes, for geophysical or transistor application requirements, etc., are available drawn in both standard steel and mu metal. 1. Input: 500 (125) ohms to 150,000 ohms C.T.; primary inductance 8.5 henries. 2. Output: 20,000 ohms C.T. to 16/8/4/2 ohms; primary inductance 1200 henries. 3. Inductors: 1500 henries, with two 2-percent taps. Special designs also available.—*Industrial Sales Div., Audio Development Co.*, 2833 *13th Ave., South, Minneapolis, Minn.*

For more information circle **295** on inquiry card.

Subminiature Transistor Transformer

New "TS001" German-made subminiature transformer is suited to transistor circuitry. Standard model shown has a primary impedance of 20,000 ohms; maximum d.c. 1 ma.; secondary impedance 1,000 ohms. Other turns-ratios or impedances on quantity order; special types developed to meet users' demands.—*Arka Imports*, 904 *San Pasqual St., Pasadena* 5, *Calif.*

For more information circle **296** on inquiry card.

Toroid Transformers

New "Series ST1-ST4" miniature toroid transformers make possible various circuits in frequency ranges

(10 to 200 kc.) which heretofore presented difficulties; are available with 2, 3, or 4 identical windings precisely spaced and having their inductances (2.3 mh. minimum and 90 mh. maximum) matched within 1 percent.—*Mico Instrument Co.*, 86 *Trowbridge St., Cambridge* 38, *Mass.*

For more information circle **297** on inquiry card.

Push-pull Transformers

New push-pull driver and alloy junction transformers are designed for use with high-power alloy junction transistors. To avoid switching transient voltages in Class B output stages and to maintain good circuit balance, bi-

filar windings are used. Frequency response 200 to 4000 cps.; power level 2 watts.—*Microtran Co.*, 84-11 *Blvd., Rockaway Beach, N. Y.*

For more information circle **298** on inquiry card.

Rectifier Kits

New vacuum-processed selenium rectifier kits save development engineer's time; contain fully assembled rectifiers marked with commercial coding. Series of seven kits comprises full range of commercially-available selenium rectifiers: complete range of sizes and rating from 3/16-in. diam. plates to 5x6-in. plates, with ratings from 1.5 ma. d.c. up to 3700 v. peak inverse to types rated at 10 amps. and 222 volts.—*Bradley Labs, Inc., New Haven, Conn.*

For more information circle **299** on inquiry card.

High-temperature VDR

New "Hot-Pot" dissipates 1 watt at 200 C.; is designed for use in computers, jet aircraft, etc.; 1-in. diam.; stainless steel case and shaft; toroidal winding on ceramic form. Available in any resistance from 1000 to 25,000 ohms.—*Waters Mfg., Inc.*, 4 *Gordon St., Waltham* 54, *Mass.*

For more information circle **300** on inquiry card.

Precision VDRs

New "Series 42-900," has been developed (and is now stocked for immediate delivery) to meet needs of prototypes, laboratory testing, etc. Resistances from 50 to 100,000 ohms in ten standard increments; rating 3 watts.—*Clarostat Mfg. Co., Inc., Dover, N. H.*

For more information circle **301** on inquiry card.

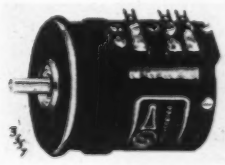
Wire-wound Controls

New "Series 43c" (1⅛-in. diam.) resistors differ from previous "Series 43": Improved wiper arm contacts edge rather than side of resistance winding; end termination improved in that terminals are directly fastened to winding; collector and terminal now in one piece; stop integral with base instead of in cover. Standard resistances from 1 to 50 kilohms; rating 2 watts.—*Clarostat Mfg. Co., Inc., Dover, N. H.*

For more information circle **302** on inquiry card.

Multiturn VDRs

Two new series of precision multiturn voltage-dividing resistors feature servo control of resistance winding.

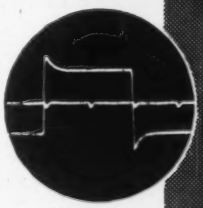


"Series MA-20-10" ten-turn units are made with standard independent linearities ranging from 0.5 to 0.02 percent (as high as 0.01 percent on special order); diam. 1.820 in.; resist-

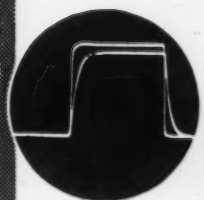
WIDE-BAND ELECTRONIC SWITCH

DC to 15 MC
Dual Trace
Oscilloscope Presentations

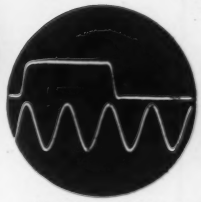
Model ES-180



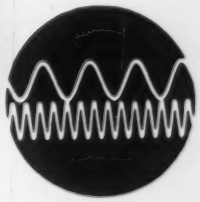
Overshoot, Rise-Time Duration Measurements



Accurate Shape, Time, Amplitude Comparisons



Simultaneous Display of Related Waveforms



Simultaneous Display of Non-Sync. Signals

- Signals displayed on alternate sweeps, switched at sweep-end, rate to 100 kc
- Amplifier rise-time .023 microseconds, megohm input, 93 ohms load impedance
- Unity-gain, feedback, regulated power supplies for linearity and stability
- Index trace calibrated in volts and % amplitude eliminates parallax errors
- Time-signal input allows accurate and rapid measurement of pulse parameters

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For more information circle **78** on inquiry card.

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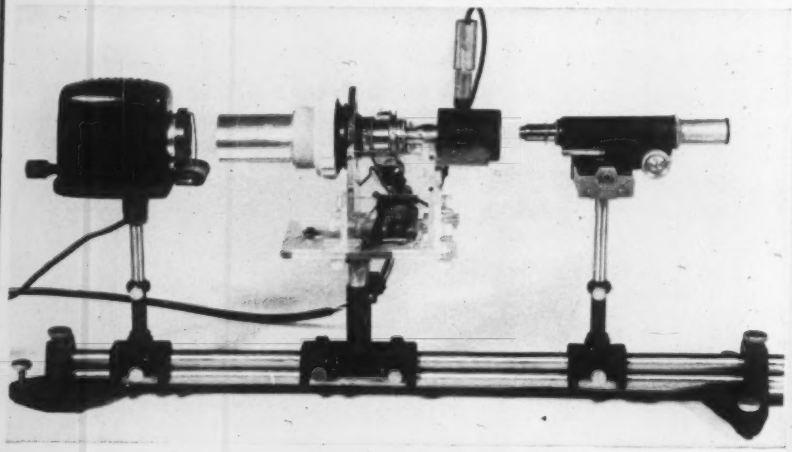

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ances from 1000 ohms to 0.1 megohm. "Series MA-30-10" ten-turn units linearities from 0.5 to 0.01 percent (as high as 0.005 percent on special order); diam. 3.000 in; resistances 2000 ohms to 0.3 megohm. Fifteen-turn models are designated "Series MA-30-15."—*Litton Industries, 336 N. Foothill Rd., Beverly Hills, Calif.*

For more information circle **304** on inquiry card.

High-stability Capacitors

New polystyrene capacitors are being produced under a new method involving a series of heating and aging cycles which improve stability: capacitance drift is less than 0.1 percent over a temperature range from –80 C. to 75 C.; change due to temperature coefficient of capacitance is less than 1.5 percent from –60 C. to 85 C. New units can therefore be used as standard capacitors in decade capacitance boxes, etc.—*Condenser Products Co., 140 Hamilton St., New Haven, Conn.*

For more information circle **305** on inquiry card.

Ceramic Capacitor

New "Style S-3" UHF stand-off subminiature ceramic capacitor (shown full size) features ruggedness which enables it to be handled in production without precautions normally used in assembling subminiature parts; may be had in any ceramic dielectric material, in capacitance values from 2 to 3300 mmf.—*Mucon Corp., 9 St. Francis St., Newark 5, N. J.*

For more information circle **306** on inquiry card.

ELECTROMECHANICAL COMPONENTS

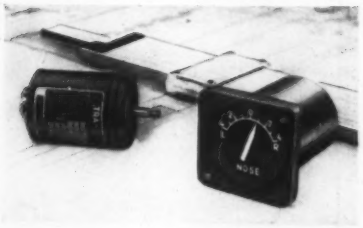
Sine-cosine Generator

New miniature a-c. permanent-magnet generator for indicating rotating shaft position by providing two voltages (sine and cosine of shaft position) can operate up to 6000 rpm. with a maximum harmonic content of 3 percent; is built to military specifications for high and low temperature operation; contains stainless steel ball bearings for corrosion resistance; is available in 1.43-in. dia. and 1.67-in. dia. with identical operating characteristics but larger size can be provided with a seal at terminal block and for use in hermetically sealed assemblies.—*Arga Div., Beckman Instruments, Inc., South Pasadena, Calif.*

For more information circle **307** on inquiry card.

Position Indicator

New "Remote Position Indication System" features a miniaturized indicator designed for applications where weight and space are critical; utilizes a 3-wire d-c. synchro drive;

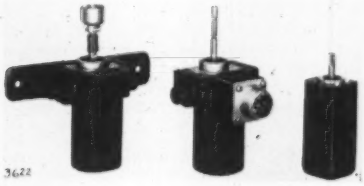


employs a tapped transmitter winding and a 3-coil electromagnetic type indicator. Accuracy is unaffected by environmental conditions or cable length. Magnetic "pull-off" holds pointer off scale for pilot warning in event of power failure. Single and multiple indications, as well as special configurations for specific applications, are available.—*Avien, Inc.*, 58-15 *Northern Blvd., Woodside* 77, *N. Y.*

For more information circle **308** on inquiry card.

Miniature Motors

Three new miniature motors for use in actuators or other high-speed applications: "No. 452008" split series type 24 v.dc. or 110 v.ac. rated at

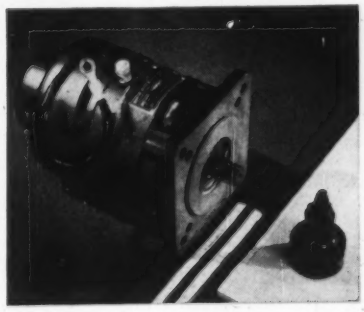


2.5 oz.-in. for intermittent duty to 160 F., available for unirotational and reversible operation; with or without integral filter; size 3x3x2½ in. ★"No. 1007690" is a "square" motor type designed to AN-M-40 and MIL-E-5272, is rated at 4 oz.-in. intermittent duty to 165 F.; split series 24 v.dc. for unirotational or reversible operation, with or without a magnetic brake; size 1 in. square by 2 in. long. ★"No. 406046" is a shunt field type 24 v.dc. unirotational only; 1 oz.-in. for continuous duty to 160 F.; incorporates thermistors in field to compensate for temperature effect on motor speed. Weight 13 oz.—*Pacific Div., Bendix Aviation Corp., N. Hollywood, Calif.*

For more information circle **309** on inquiry card.

Speed-regulated Motor

New "Type SC-5" provides starting torque of 110 lb-in.; produces 1 hp. at 12,000 rpm. regulated to 6 percent in



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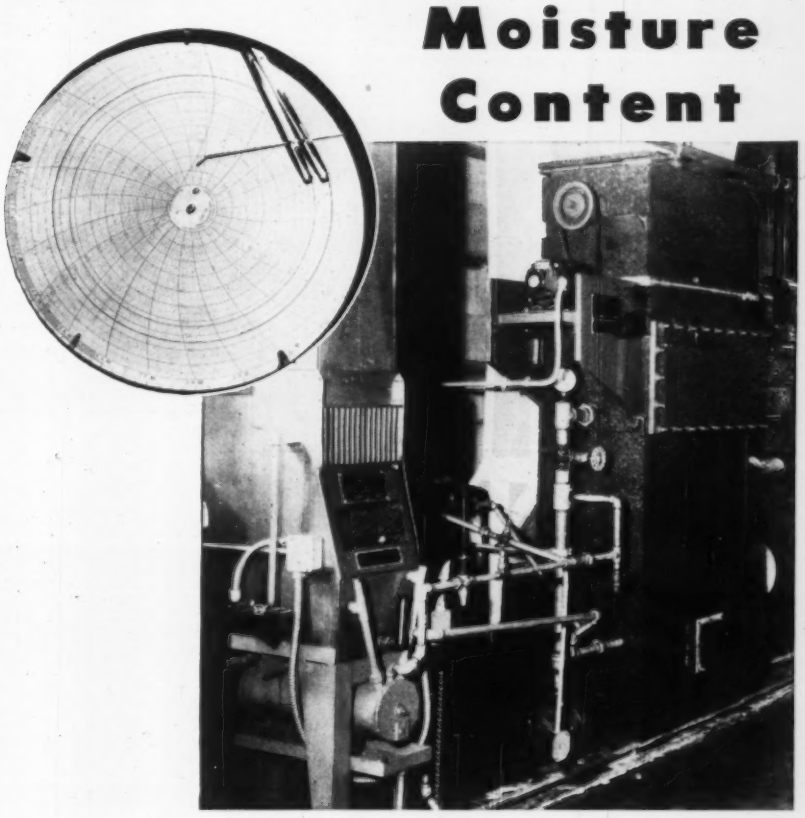

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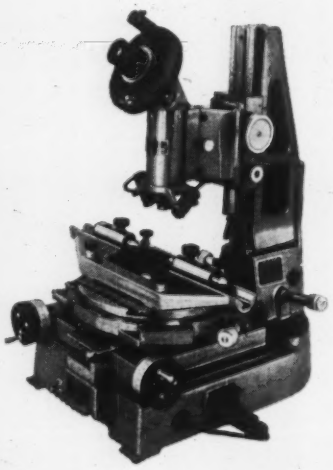

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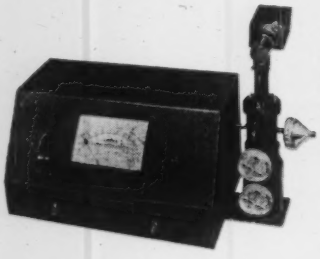

AIR POLLUTION PHOTOMETER

The new *Sinclair-Phoenix Aerosol and Smoke Photometer* employs the forward scattering principle which offers the most practical, intelligent method of accurate air pollution studies, measurements and control.

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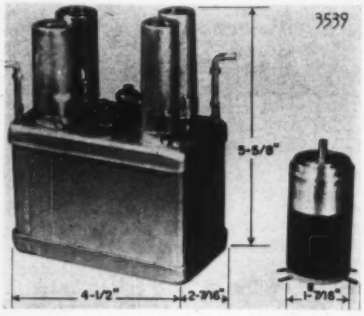
speed variation; draws 45 amps.; operates over d-c. voltage range of 25 to 29.5; regulates over a load variation of 2/3 to 1 hp.—*Dalmotor Co.*, 1343 *Clay St., Santa Clara, Calif.*

For more information circle **310** on inquiry card.

Packaged Servo System

New 1½-watt packaged servo system comprises amplifier, motor and gear train. Amplifier is equipped with screw driver adjustments to peak system to a wide variety of load condi-



tions. Available in 60- and 400-cps. models for follow-up systems, laboratory and industrial instrumentation, computers, etc.; also available with higher power outputs and for use with d-c. systems.—*Feedback Controls, Inc.*, 1332-34 *N. Henry St., Alexandria, Va.*

For more information circle **311** on inquiry card.

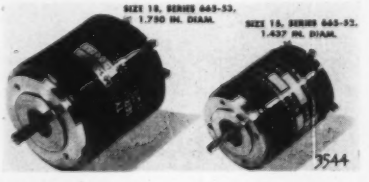
Instrument Servomotor

New two-phase 60-cps. instrument servomotor, available in 1- and 5-watt ratings, features integrally molded stator and housing. Liberal design characteristics assure long life under severe ambient temperature conditions. If desired, motor can be wound with high-impedance control winding for operation directly from plates of electron tubes. Though intended primarily for commercial use, new motor meets pertinent JAN specs for resistances to humidity, salt spray, fungus, shock and vibration.—*Diehl Mfg. Co., Somerville, N. J.*

For more information circle **312** on inquiry card.

Servomotors

Two new 2-phase induction servomotors are designed for use in computers, guided missiles, radar, etc.; are available in 2-, 4-, and 8-pole mod-



els for 400 or 60 cps.; can be supplied to meet performance specs for military servomotors Mark 7 and Mark 8. Control phase can be wound for connection by user for either series or parallel operations.—*G-M Laboratories, Inc.*, 4300 *N. Knox Ave., Chicago* 41, *Ill.*

For more information circle **313** on inquiry card.

Miniature Relay

New "Type TS" miniature telephone-type d-c. relay is available with coils for all standard voltages up to 125 v.dc. or 6500-ohm coil. Special coils available for ambient temperatures from –65 C. to 125 C. Shock and acceleration: up to 50 *G;* vibration: 10 *G* at 5 to 500 cps. depending on contact sizes and combinations. Can be supplied hermetically sealed.—*Comar Electric Co., 3349 Addison St., Chicago* 18, *Ill.*

For more information circle **314** on inquiry card.

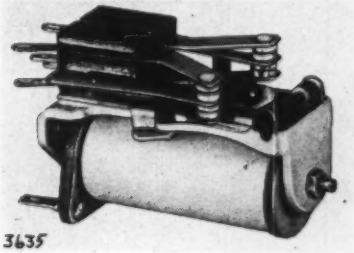
Aircraft Relay

New "Part No. DC-36" d-c. relay, for use under severe service conditions, is evacuated, filled with an inert gas, and sealed off; exceeds electrical and mechanical requirements of MIL-R-5757. Contacts are 6-p.d-t. (break-before-make) pure silver; 2 amps. at 26.5 v.dc. resistive load, input sensitivity 72 milliwatts. Terminals are closed loop type (also available with spade, plug-in or AN connector, on order). Weight 4 oz.; max. over-all height 1.93 in.—*Deltronic Corp., 9010 Bellanca Ave., Los Angeles* 45, *Calif.*

For more information circle **315** on inquiry card.

Power Relay

New "Type J" power relay is said to be "as sensitive and accurate as a telephone-type relay." It has handled inrush currents of 50 amps. for 50,-



000 operations with a rating of 10 amps. 27½ v.dc. It has exceeded 500,-000 operations on motor load of 6 amps., inrush current of 15 amps. at 70,000 ft. altitude.—*C. P. Clare & Co., 4101 West Pratt Blvd., Chicago* 45, *Ill.*

For more information circle **316** on inquiry card.

Snap Switches

New "W H B" precision snap switches feature movement differential of 0.0005 in. maximum and low actuating force; are particularly suitable for use in pressure-sensitive thermostatic controls and short-motion gaging devices. Three styles of over-travel plungers: "stubby," threaded sleeve, and small over-travel plunger. Basic switch is Underwriters' listed at 15 amps. 125/240/480 v.ac.—*The W. L. Maxson Corp., 460 W. 34th St., New York* 1, *N. Y.*

For more information circle **317** on inquiry card.

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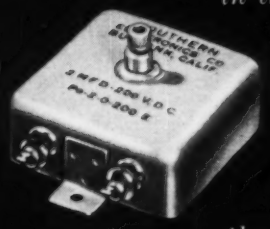
with Accuracy in the order of 0.1% or better and Long Time Stability in the order of 0.03%



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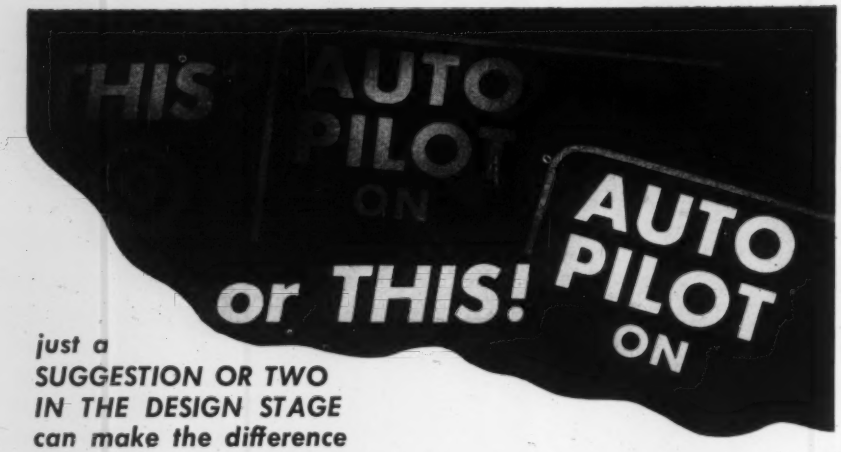

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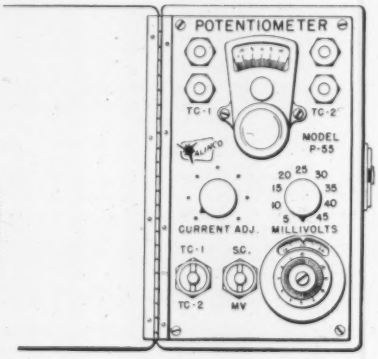
A miniaturized POTENTIOMETER



The miniaturized Potentiometer, Model P-55, weighs only three and one half pounds, and measures just 4 1/8 x 4 1/2 x 7 1/2 inches, yet is accurate to 0.02 millivolts. The dual input is equipped with an internal switch. The battery life is two years. $215.00

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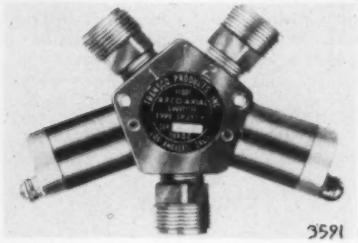
NEW INSTRUMENTS

R-f. Coaxial Switch

New miniature r-f. coaxial switch features versatility to meet exacting requirements of modern microwave



components and MIL-E-5272. Frequency range 0 to 8000 Mc. Stacking dimensions 0.850 x 2.48 in.—*Transco Products, Inc.*, 12210 *Nebraska Ave., Los Angeles* 25, *Calif.*

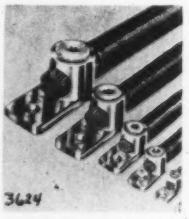
For more information circle **318** on inquiry card.

Subminiature Jack and Plug Combination

New subminiature closed-circuit jack and plug combination, approx. 1/3 size of previous models, for use in computers, tape recorders, dictating machines and miniature radios.—*Dep't KP, Telex, Inc.*, 1633 *Eustis Ave., St. Paul, Minn.*

For more information circle **319** on inquiry card.

Terminal Lugs

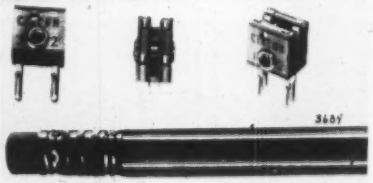


Three new types of "Hi-Strength Terminal Lugs" for terminating and joining copper and aluminum conductors are cast of high-strength corrosion-resistant copper alloy, tin- or silver-plated for aluminum conductors. Tangs are machined and chemically treated to maintain low surface resistance. Socket or hex head set screws.—*Jasper Blackburn Corp.*, 35 *Madison St., St. Louis* 6, *Mo.*

For more information circle **320** on inquiry card.

Subminiature Connector

New "Model SM4F116," said to be "the smallest multiple circuit connector known today" (weight about 1/40 oz. and less than 0.03 cu. in.) is a



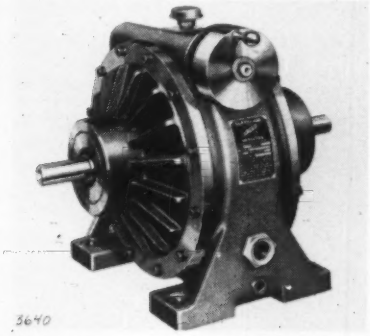
4-contact female connector usable in both graphic circuit and conventional cabling applications; permits side-by-side and end-to-end mounting of any desired combination; rated maximum load 1 amp. per contact.—*Circon Component Co.*, 17544 *Raymer St., Northridge, Calif.*

For more information circle **321** on inquiry card.

MECHANICAL COMPONENTS

Variable-speed Drives

New "Speed Variator" is available in 9 sizes, from 0.5 to 10 hp. at 1750 input rpm. Among unique features: power transmitted from input shaft

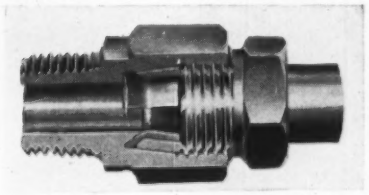


through alloy steel driving balls which are in pressure contact with disks attached to the two shafts. Range from ⅓ to 3 times input speed, infinitely-variable. Coaxial input and output shafts rotate in same direction, either clockwise or counter-clockwise. Speed regulated by manual or power-operated remote control devices.—*The Cleveland Worm and Gear Co.*, 3249 *E. 80 St., Cleveland* 4, *Ohio.*

For more information circle **322** on inquiry card.

Self-flaring Fittings

New "Flare-Matic" self-flaring pressure-tight fittings are available in ¼-inch., ⅜-in. and ½-in. sizes in a

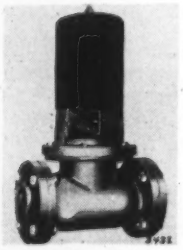


variety of types and materials. No flaring tools are used: operator inserts tube into fitting and tightens nut with ordinary wrench to form standard SAE and JIC 37-degree seat.—*Century Products*, 315 *S. 15th St., Philadelphia* 2, *Pa.*

For more information circle **323** on inquiry card.

VALVES

Motorized Gas Valves



New motorized valves for automatic fuel control on gas-fired equipments feature two-wire motor operator, soft neoprene seat construction, and sturdy lightweight aluminum body (FM approved). Diaphragm "open" or "closed" indicator on mounting brac-

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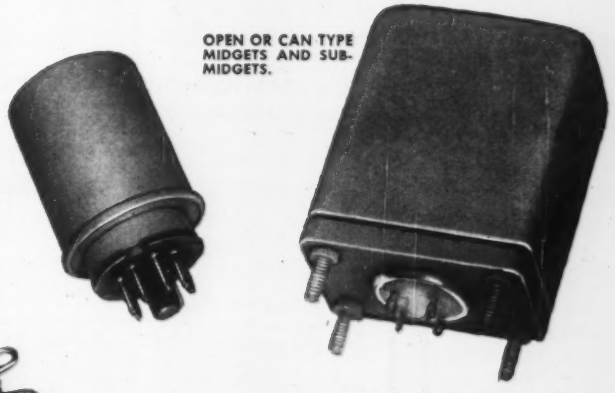
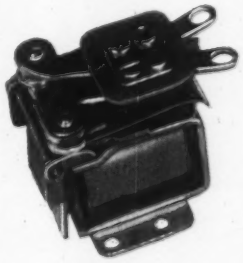


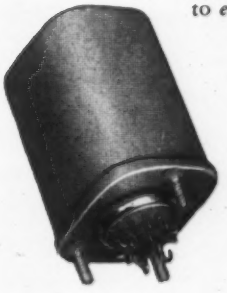
A WIDE VARIETY OF SPRING AND COIL COMBINATION, OPERATING POTENTIALS AND CONTACT RATINGS.



How do you compare relays? Comparison can be made on the basis of craftsmanship, uniformity of performance, dependability . . . and AEMCO invites such comparison. Comparative quality is relative but absolute quality is more certain!

We believe that the long and continuous servicing of more than one hundred top names of American Industry establishes the uniform dependability of AEMCO 'Engineered' RELAYS.

If one of the hundreds of stock AEMCO Relays does not exactly fit your requirements, we will design and manufacture to meet your particular needs . . . to *exceed your specifications!*



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★ DELAYED MAKE OR BREAK
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★ CURRENT AND POTENTIAL RELAYS

WRITE TODAY *for complete information on AEMCO Relays to meet your requirements and exceed your expectations!*

AEMCO *Automatic Electric* MFG. CO.

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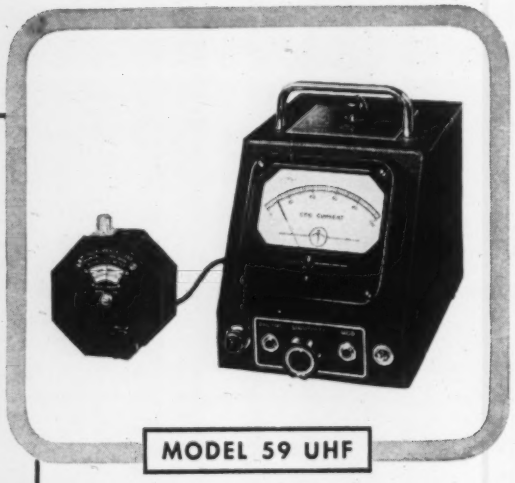
For more information circle **86** on inquiry card.

NEW UHF MEGACYCLE METER

With the Widest Frequency Coverage in a Single Band



FEATURES

- Excellent coupling sensitivity.
- Fixed coupling point.
- Small grid current variation over band.
- Calibration point every 10 Mc.
- Uses split-stator tuning condenser with no sliding metal contacts.
- Standard camera socket for tripod fixtures.
- Octagonal case for convenient positioning.
- Useful in television transmitting and receiving equipment.

SPECIFICATIONS

FREQUENCY RANGE: 430-940 Mc in a single band
FREQUENCY ACCURACY: ±2% (Individually calibrated)
OUTPUT: CW or 120-cycle modulation
POWER SUPPLY: 117 volts, 60 cycles, 30 watts
DIMENSIONS: Oscillator Unit 4⅜" x 2½"
Power Unit 5⅛" wide x 6⅛" high x 7½" deep

Laboratory Standards **MEASUREMENTS CORPORATION**
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13-19 University Place, New York 3, N. Y.

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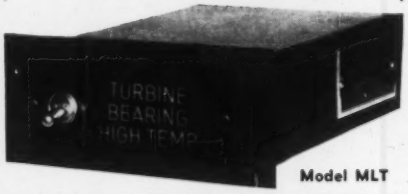
KIRKLAND ALARM UNITS

MODERN SUPERVISION



Model MLT

FLUSH TYPE HOUSING FOR MOUNTING IN A SINGLE OPENING IN A PANEL. Face plate 5" x 2¼"

COMPLETE SELF-CONTAINED ALARM UNIT WITH LAMPS, RELAYS AND SWITCH, FACTORY WIRED AND READY FOR USE.

Model VIG IS A WIRING DEVICE THAT MOUNTS ON A STANDARD OUTLET BOX. PLATE IS 4½" Sq.

VISUAL AND AUDIBLE ALARMS

MANY INTERESTING SERVICES AVAILABLE, for example our #200. When the contacts become abnormal, red and green lamps light and audible signal sounds, switch operation removes audible signal and only red lamp remains lighted. When contacts restore to normal, the audible signal sounds automatically and only green lamp is lighted. Switch operation silences acknowledgment audible signal and all lamps are darkened. ALL STANDARD ANNUNCIATOR SERVICES AVAILABLE.

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THE H. R. KIRKLAND CO.
MORRISTOWN, N. J.
Est. 1930

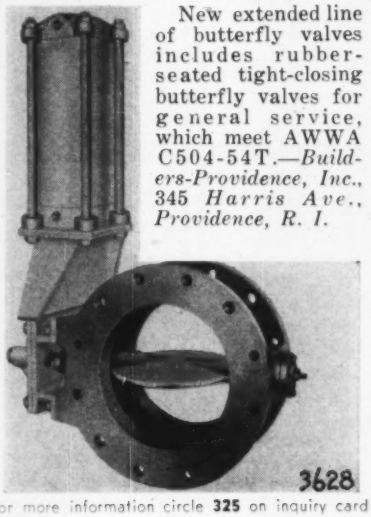
For more information circle **89** on inquiry card.

NEW INSTRUMENTS

ket. Flange mountings with aluminum companion flanges are standard. Sizes 1 to 4 in.—*Eclipse Fuel Engineering Co., Rockford, Illinois.*

For more information circle **324** on inquiry card.

Butterfly Valves



New extended line of butterfly valves includes rubber-seated tight-closing butterfly valves for general service, which meet AWWA C504-54T.—*Builders-Providence, Inc., 345 Harris Ave., Providence, R. I.*

For more information circle **325** on inquiry card.

MISCELLANEOUS

Leak Detector

New "Type 24-110" is said to be "the most sensitive commercially available instrument for production line testing operations"; has ten times the sensitivity of maker's "24-110A Leak Detector"; is a simplified mass spectrometer capable of detecting one part of helium in two million parts of air.—*Consolidated Engineering Corp., Pasadena 8, Calif.*

For more information circle **326** on inquiry card.

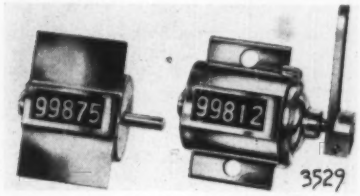
High-speed Flip-flop

New high speed flip-flop for use in counting and frequency division applications has 0 to 1 Mc. range for decade operation; 11-pin base plug-in. Minimum input signal 80 volts for input frequencies from 0 to 500 kc.; output signal amplitude 80 volts. Unit can be taken apart or assembled without use of any tools.—*Eeco Production Co., 827 S. Vermont Ave., Los Angeles 5, Calif.*

For more information circle **327** on inquiry card.

Die-cast Counters

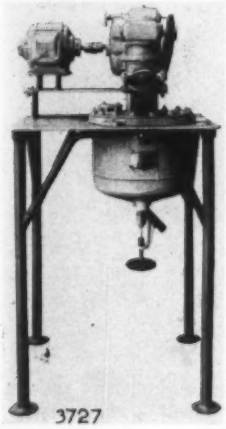
New "Micro Meters" feature ¾-in. die-cast zinc case; are available with



3, 4 or 5 digits, in types and styles to suit most applications.—*Durant Mfg. Co., 1914 N. Buffum St., Milwaukee 1, Wis.*

For more information circle **328** on inquiry card.

Packaged Pilot Plants



New reaction-distillation pilot plants, from 5- to 60-gal. capacities, consist of reactor, condenser, receiver, decanter, piping, valves and instruments in one unit.—*The Patterson-Kelley Co., Inc., East Stroudsburg, Pa.*

For more information circle **329** on inquiry card.

Camera Tube

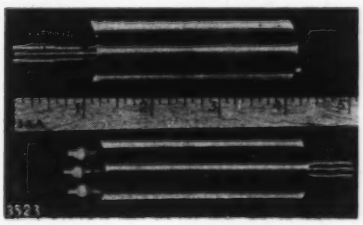
New "Resitron 6198," for industrial, military, television broadcast, and amateur uses, is said to combine high sensitivity and resolution together with long life. Photoconductive spec-

tral response approximates that of human eye (different spectral responses available). Tube design is adaptable to a wide selection of commercially-available lenses.—*Resitron Laboratories, Inc., 2025 Pontius Ave., Los Angeles 25, Calif.*

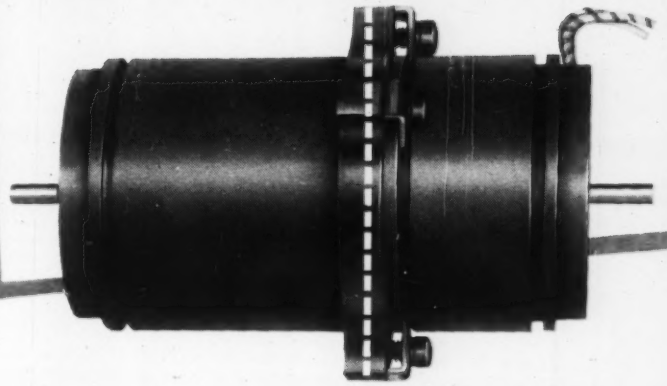
For more information circle **330** on inquiry card.

High-temperature Linear Displacement Pickup

New "Extensometer Micrometer" requires no cooling at temperatures up to 1300 F. (bright red); utilizes



GEARED FOR
FAST RESPONSE



Gear Reducer + Instrument Servo Motor

Now! **DIEHL** offers this Instrument Servo Motor with a Gear Reducer attractively priced for commercial applications in five different ratios. Either the motor, gear reducer or both can be quickly replaced avoiding costly down-time. The spur gear construction insures good efficiency.

GEAR REDUCTION RATIOS	SERVO MOTOR SPECIFICATION		
	Output (Watts)	1	5
191.1	Frequency (Cycles)	60	60
79.6	Poles	2	2
32.4	Reference Phase (Volts)	115	115
13.8	Control Phase (Volts)	50	115
5.8	Reference Phase (Watts)	10	17
to 1	Control Phase (Watts)	3.5	17
	Control Phase Impedance (Ohms)	555	575

Our engineering staff will gladly help you select the motors best suited to your specific requirements. A request on your letterhead will bring you a copy of Technical Manual No. IN -0155 describing Diehl Servo Motors and related equipment.

Other Available Components:
D.C. SERVO SETS • RESOLVERS
MINIATURE PERMANENT MAGNET D.C. MOTORS

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Finderne Plant, SOMERVILLE, N. J

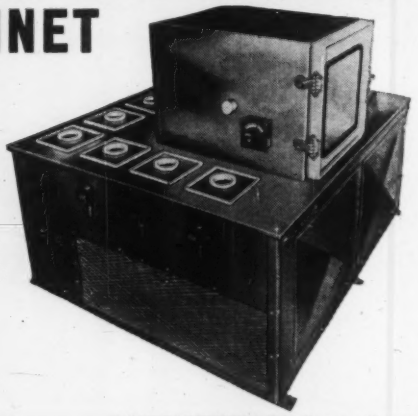
For more information circle **90** on inquiry card.

ANOTHER INTERNATIONAL RADIANT FIRST!!

A TEMPERATURE CALIBRATION CABINET

Featuring:

SEVEN TANKS and ONE CHAMBER



- Permits closely controlled calibration and testing of remote temperature sensing devices.
- Temperature in each tank controlled to ±¼° F.
- Separate cooling or heating systems for each tank.
- Altitude conditions also available in chamber.
- Separate control of temperature and humidity in the chamber to tolerances ±2° F. closer tolerance possible.
- Illustrated unit has 7 tanks (—60° c. to +60° c.)
- Chamber temperature range — 70° c. to +60° c.

MANUFACTURERS OF: Vacuum Ovens, Brine Chillers, Diaphragm Exercisers, Rain Makers, Special Air Conditioning Equipment, Super Vacuum Systems, Explosion Chambers, Sunshine Chambers, Plastic Bell Jar Systems, Immersion Test Equipment, Low Temperature Test Equipment—Humidity Controlled Test Equipment, Altitude and Vacuum, Sand and Dust, Walk-In Rooms, Salt Spray, Fungus, Sublimators, Liquid Hot and Cold Baths, Mobile Refrigeration.

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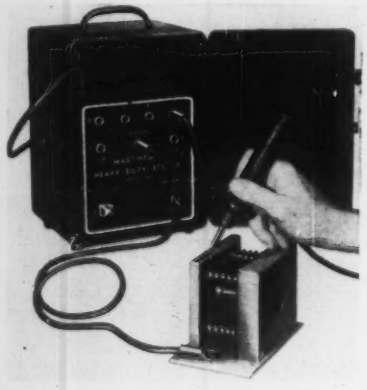
For more information circle **91** on inquiry card.

MARTINDALE

HEAVY DUTY ETCHER



Model A-A has wide use as a production-line etching tool. With six heats it is effective on small parts and also on large pieces such as shovels, castings, etc. Complete with ground lead, heavy metal case, etc. Also, three other models of electric etchers for iron and steel, and one mechanical marker for copper, aluminum, plastic, etc.

Write for 64-Page Catalog No. 29 describing many products for Industrial Maintenance, Safety and Production.

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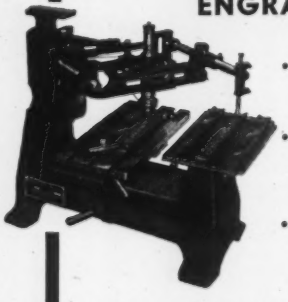
For more information circle **92** on inquiry card.

PREIS-PANTO

ENGRAVER



- Ratios from 1.7:1 to 7:1
- Areas at 2:1 ratio —4-5/16" sq. 4½" circle
- Areas at 7:1 ratio —1⅛" sq. 1⅜" circle

A high precision, sturdily constructed, widely adaptable machine for engraving steel stamps, dies, other metals, plastics, fibre, wood, etc.

By simple attachment of additional accessories this machine may also be used for ELECTRICAL MARKING and ACID ETCHING.

Several models available for 2 and 3 dimensional engraving.

Write for NEW Bulletin B-1 of the complete line and ask for catalog UE-3 with price lists.

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661 U.S. Highway 22 Hillside, N. J.

For more information circle **93** on inquiry card.

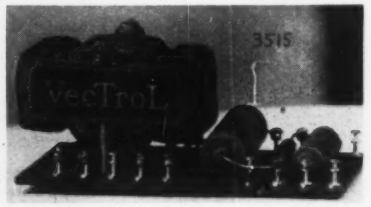
NEW INSTRUMENTS

variable-permeance bridge principle with output capable of operating most industrial indicators or recorders. Resolution 0.1 microinch; available ranges 1 in. to 32 in.; no force required for displacement of probe.—*Crescent Engineering & Research Co.*, 14828 *Arrow Highway, Baldwin Park, Calif.*

For more information circle **331** on inquiry card.

Phase Shifter

New "VecTrol" network of four static components provides phase shift up to 360 deg. Linear proportional phase shift of 180 deg. is obtainable with small change of either inductance or capacitance. Among configurations: (1) Photo shows "Vec-Trol" using saturable reactor as variable

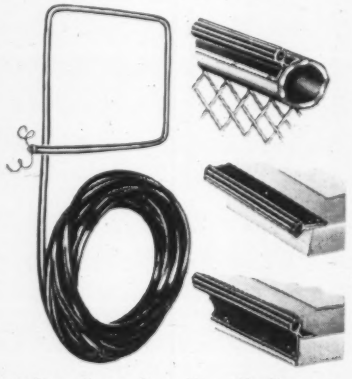


inductance for control of thyratron outputs up to several kilowatts with d-c. control signal less than 1 milliwatt. (2) Using thermal element to control thyratron from zero to maximum with temperature change as little as 0.5 F. deg. (3) Using inductance or capacitance pickup to control thyratron output. (4) For phase or frequency modulation of radio transmitters for telemetering, etc.—*Brownthorn Electronics, Inc., P. O. Box* 1089, *Stamford, Conn.*

For more information circle **332** on inquiry card.

Continuous-tube Form Hydraulic Switch

New "Hydratube" is a hydraulically-operated electrical switch self-contained in a ½-in. diam. flexible plastic tube. Adjustment can be made so that pressure as low as 1 oz. will actuate switch when installed hori-

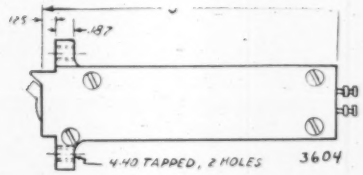


zontally. Capacity of palladium contacts is approx. 1 amp. when switch is adjusted to require 6 to 8 oz. pressure. Standard lengths 6 and 12 ft.; up to 300 ft. to order. "Hydratube" can be used as is, but a special rubber extrusion is available for mounting on various surfaces.—*The Recora Co.*, 56 *W.* 103*rd St., Chicago* 28, *Ill.*

For more information circle **333** on inquiry card.

Hand-reset Signal

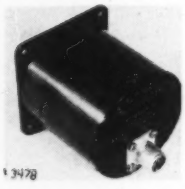
New "Rotary Indicator" is a combination annunciator, latching relay and overload circuit breaker. As annunciator: signal releases latch (shown edgewise at left) which



swings down and exposes face. Latch is reset with finger but will not stay up if signal is still on. Latch controls s-p.d-t. relay contacts. New unit is for use on airborne (as well as industrial) control panels, as it withstands 10 *G* in any position.—*Allard Instrument Corp.*, 30 *Broad St., New York* 4, *N. Y.*

For more information circle **334** on inquiry card.

Altitude and Airspeed Transmitters

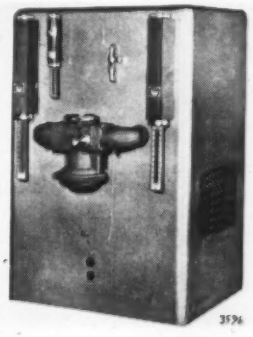


New altitude and airspeed pickups meet MIL - E - 5272A. Particular attention has been given to improved performance at temperatures up to 160 C. and to dynamic stability as required by military specs. Altitude series (linear with altitude or pressure) 0-90,000 feet with resolution as high as 600 ft. at 90,000 ft. Airspeed units 100-700 mph. range, linear with either pressure or airspeed to 0.75 percent and resolving 0.25 percent.—*Rahm Instruments, Inc.*, 12 *W. Broadway, New York* 7, *N. Y.*

For more information circle **335** on inquiry card.

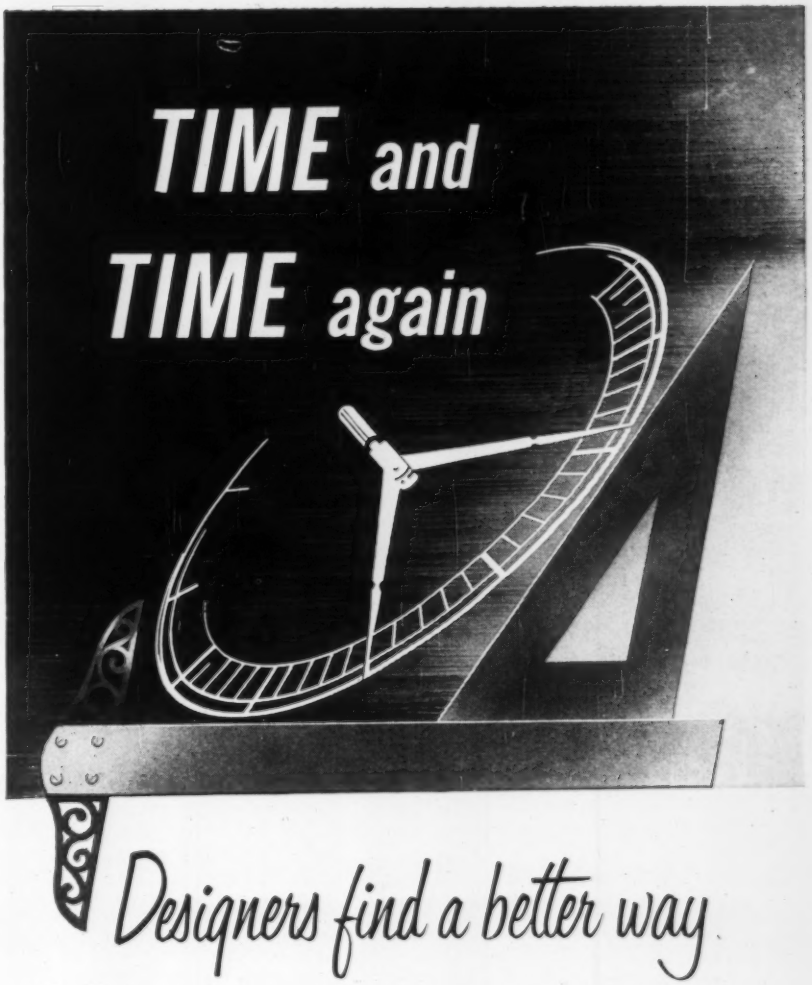
Carbureting Machine

New "Mixor" gas-air mixing and carbureting machine is supplied as a complete package with vane-type com-



pressor, 1750-rpm. motor drive through v-belt, motor adjusting base, air filter, pressure relief valve, gas zero governor, lubricator, carburetor and flowmeters all mounted and factory piped.—*Waukee Engineering Co., Inc.*, 407 *E. Michigan St., Milwaukee* 3, *Wis.*

For more information circle **336** on inquiry card.



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When better performance depends on unexcelled timing components, it pays to look to HAYDON*. Engineers can rely on HAYDON Timing Motors and Timing Devices to give products precise, exacting control of Time to better serve the user.

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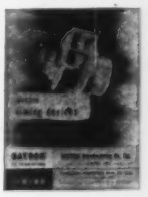

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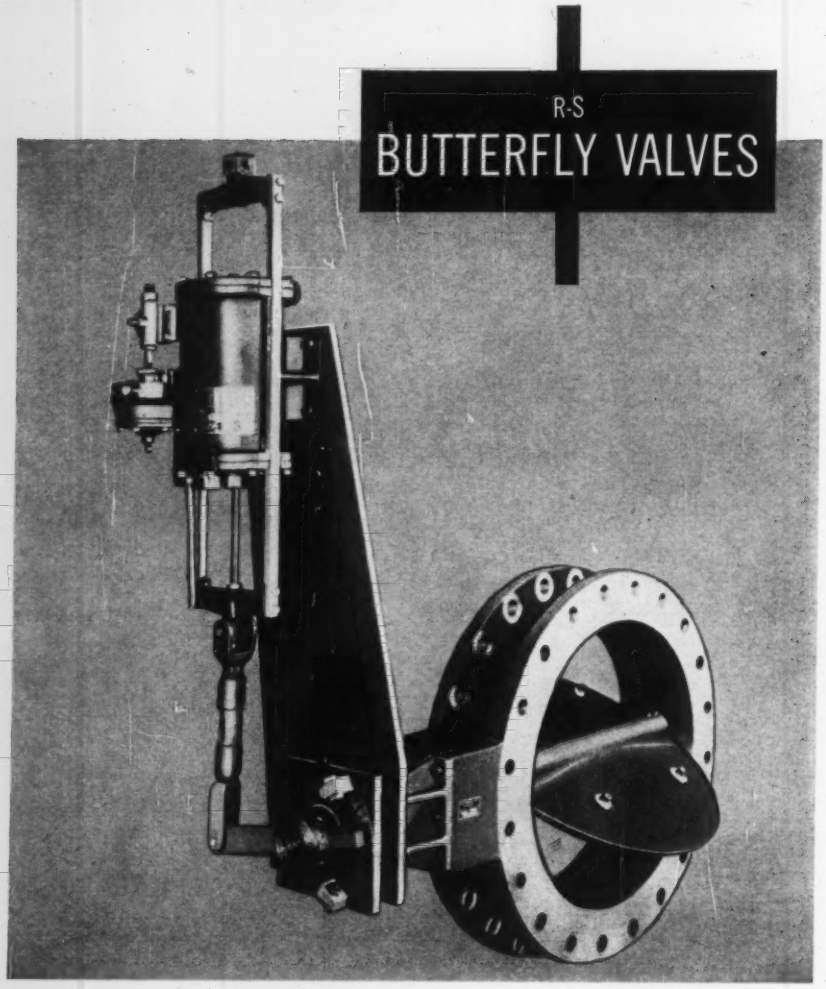

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Events . . .

January 27-28

Fourth Annual Instrument Short Course at Los Angeles Harbor Junior College, Wilmington, Calif. For information write J. R. Wilson, SCMA, 640 Fillmore St., Fillmore, Calif.

January 31—February 2

Sixth Annual Southeastern Instrumentation Symposium will be held on the Campus of the University of Florida. For information write W. C. Hackler, Engineering and Industrial Experiment Station, University of Florida, Gainesville, Florida.

February 2-3

New York Sec., Instrument Society of America Winter Conference will be held at Hotel Statler, N. Y. Theme: Instrumentation For Data Reduction and Presentation. For information contact: Hamilton Bristol, Bristol Co., 250 W. 57th St., N. Y., N. Y.

February 7-8

Second Annual Symposium on Instrumental Analysis, sponsored by the Chicago Section, I.S.A. will be held at the Auditorium of the Western Society of Engineers, 84 E. Randolph St., Chicago, Ill. For information write Floyd Ertsman, Rm. 1420, 343 S. Dearborn St., Chicago, Ill.

February 28-March 4

Sixth Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, William Penn Hotel, Pittsburgh. For information write J. F. Miller, Mellon Institute, 4400 Fifth Ave., Pittsburgh 13, Penna.

March 1-3

1955 AIEE, IRE, and ACM Western Computer Conference and Exhibit will be held at the Statler Hotel in Los Angeles. For information write Institute of Radio Engineers, 1724 West Main St., Alhambra, Calif.

March 6-12

American Society of Photogrammetry and American Congress on Surveying & Mapping Consecutive Meetings will be held at Shoreham Hotel, Washington, D.C. For information write ASP Chairman J. W. Cain, 7004 17th Ave., Hyattsville, Maryland, or ASCM Chairman W. S. Dix, Rm. 435 Woodward Bldg., Washington 5, D.C.

March 8-10

Fifth Annual Conference on Instrumentation in the Iron and Steel Industry, sponsored by the Pittsburgh Sec., Instrument Society of America will be held at the Hotel William Penn, Pittsburgh, Pa. For information write A. F. Robbins, Crucible Steel Co., Midland, Pa.

April 27-29
Society for Experimental Stress Analysis 1955 Spring Meeting will be held at Hotel Statler, Los Angeles, Calif. For information write W. M. Murray, P. O. Box 168, Central Square Station, Cambridge 39, Mass.

May 2-5
Annual Research Equipment Exhibit and Symposium in Instrument Techniques and Applications, National Institutes of Health, Bethesda, Maryland. For information, write to the Supply Management Branch of NIH.

May 14-22
Chemical Engineering and Equipment Exhibition at Frankfort, Germany. For information write Dechema, Rheingan-Allee 25, Frankfort/M, Germany.

May 23-27
Third Annual Conference on Mass Spectrometry, sponsored by the ASTM Committee E-14 will be held at the Mark Hopkins Hotel, San Francisco, Calif. For information write J. G. Hutton, General Electric Co., 1 River Rd., Schenectady, N. Y.

June 13-17
Annual Symposium on Molecular Structure and Spectroscopy, Ohio State University. For information write Prof. Harold H. Neilsen, Dept. of Physics, Ohio State University, Columbus 10, Ohio.

June 28-July 9
Third British Instrument Industries' Exposition at Earl's Court, London. For information write F. W. Bridges & Sons, Ltd., Grand Bldg., Trafalgar Square, London W. C. 2, England.

August 24-Sept. 3
12th Annual British National Radio Show will be held at Earls Court, London, England. For information write Andrew Reid, 11, Garrick St., London WC. 2, England.

September 12-16
Tenth Annual Conference and Exhibit of the Instrument Society of America will be held at Shrine Exposition Hall and Auditorium, Los Angeles, Calif. For information write Fred J. Tabery, 3443 South Hill St., Los Angeles 7, Calif.

October 5-14
Tenth General Conference on Weights and Measures will be held in Paris and Sevres, France. For information write National Bureau of Standards, U. S. Dept. of Commerce, Washington 25, D. C.

November 14-17
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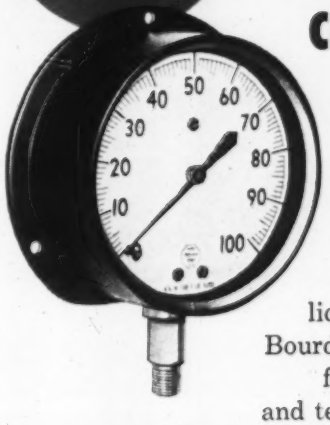

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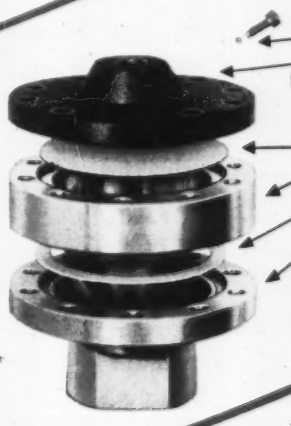

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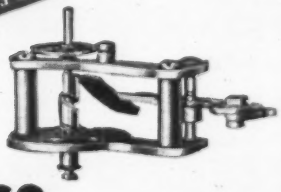

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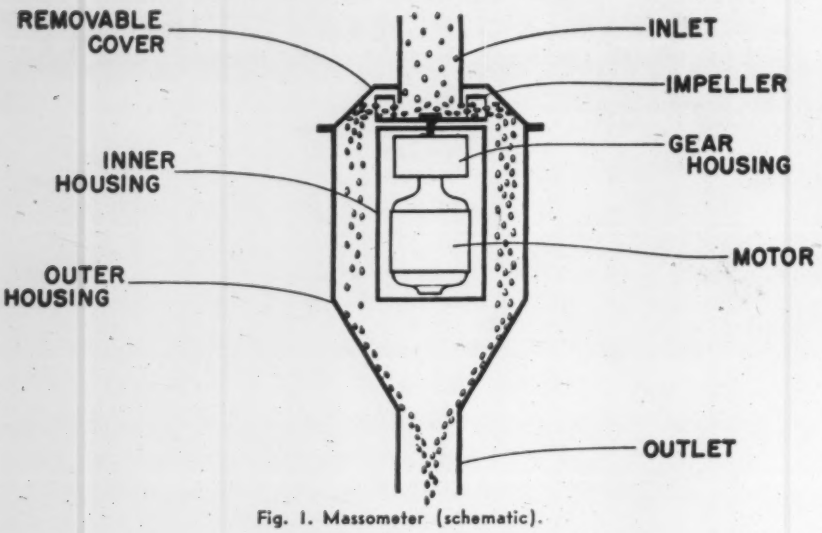


Fig. 1. Massometer (schematic).

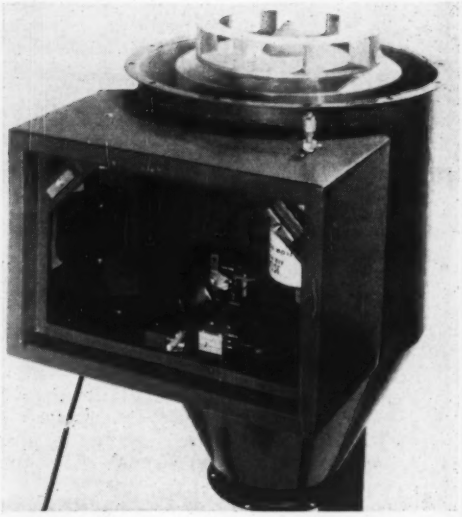


Fig. 2. Massometer with impeller exposed.

Continuous Weighing

Continuous processing of solid materials is now a new and vast field. A new flowmeter, the Massometer, measures the mass rate of flow of free-flowing solids from the torque produced in accelerating the materials. Applications of the Massometer, and of automatic gravimetric feeders of the weigh-belt types are presented.

Massometers

MASSOMETER is a force-balance instrument designed to measure the mass rate of flow of free-flowing solids, liquids, or slurries. It resembles a motor-driven centrifugal pump with its axis of rotation in the vertical plane. The design of the sheet-metal housing, the location of the impeller and the driving mechanism, along with the flow path of the material being metered, are shown in Fig. 1.

The housing is essentially a cylinder within a cylinder. The inner cylinder contains the motor, the geared speed-reducer, and most of the force-balancing components. The openings are gasketed to prevent the entrance of dirt and foreign matter. As an extra precaution a small amount of air is bled into this housing so that slight pressurization is maintained at all times. Structural attachments, offering a minimum of obstruction to the flow, centrally support the inner housing with respect to the outer one. The annular space between the two housings forms a passageway for the material leaving the impeller.

Material entering the Massometer for measurement falls onto the center of the impeller (Fig. 2). This material has essentially zero horizontal velocity. As it passes through the impeller it is accelerated by the vanes and leaves the impeller with a horizontal tangential velocity equal to the peripheral speed of the impeller. The work done in accelerating this material is the force which is measured. This force bears a linear relationship to the pounds of material passing through the impeller and is independent of density, viscosity, temperature, or atmospheric pressure.

The motor stator and gear housing are supported in ball bearings and exert a backward torque equal and opposite to the accelerating force. As shown in Fig. 4, this backward torque is opposed by air pressure acting on a flexible metal bellows and suitable leverage. Pressure is controlled through a valve positioned by a very small movement of the motor stator. The leverage is such that 3 to 15 psi. pressure on the bellows represents zero to maximum flow. This pressure will operate any conventional pneumatic recorder, indicator, or integrator.

The Massometer is fast in detecting changes in the rate of flow because any one increment of flow is in the impeller for only a small fraction of a second. Other advantages are: (1) Its small size allows installation in crowded quarters. (2) Only one moving part is exposed to the material being measured. (3) It is easy to keep clean because of its shape. (4) It is simple to install and requires only electric service and compressed air at 30 psi. (5) It may be locked shut to prevent tampering. (6) It is light weight (approximately 50 pounds) and can be handled by one man. (7) It can be mounted on a section of vertical 2-in. pipe so that it may be swung in or out of line at will.

Massometers are made having a range of maximum capacity from 25 to 225 pounds per minute. Accuracy is within 1 percent of indicated flow from 10 to 100 percent of maximum capacity.

Fig. 3 is a portion of a typical chart covering a 24-hour run on the fine tailing stream in a large flour mill. The width of the record is the direct result of variable flow.

Contributed by the Instruments and Regulators Div. of The American Society of Mechanical Engineers at the Eighth National Instrument Conference, Chicago, Ill.

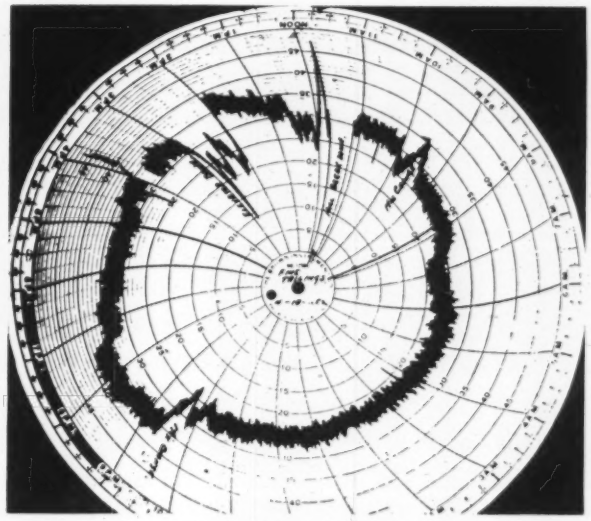


Fig. 3. Massometer chart.

and Feeding

J. O. KIRWAN and L. E. DEMLER

Wallace & Tiernan, Inc.

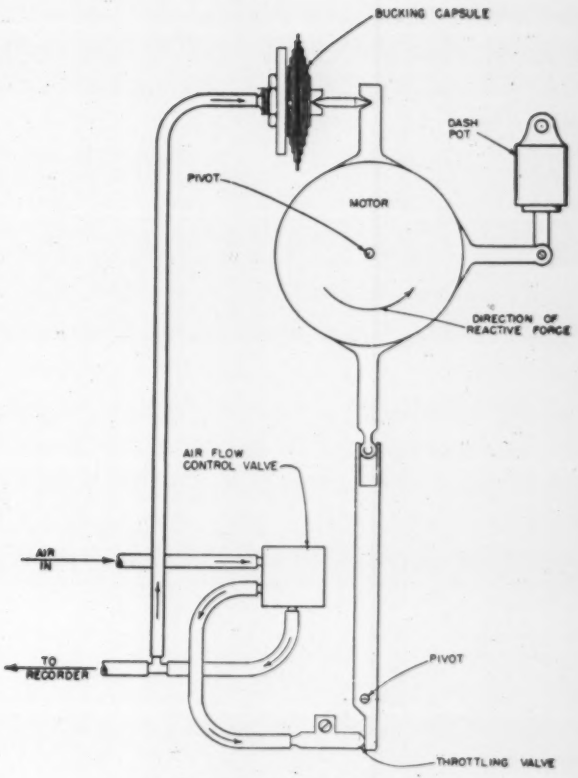


Fig. 4. Massometer force-balance system.

Where such variations in flow are excessive, either a dash pot to dampen the mechanism swing or a restricting valve in the recorder line can be used.

Our current operations limit particle size to one having a maximum dimension of one-half inch. The impeller discharge opening determines this size and, of course, could be made larger to accommodate larger particles if necessary. The maximum capacity of the Massometer is based upon material having a density of 40 pounds per cubic foot. Volumetrically, this is approximately six cubic feet per minute.

Moisture content is relatively unimportant except in applications where corrosive materials are handled or where the material is as sticky as starch or powdered glue.

The impeller in the Massometer turns at the rate of 450 revolutions per minute. Particles leaving the impeller are travelling approximately 950 feet per minute and are slowed down by striking a metal surface at 25 degree included angle. This would undoubtedly break up some small percentage of weak brittle material.

Maintenance on the Massometer is almost completely one of keeping the impeller free of foreign matter. No lubrication is required, although an air filter in the compressed-air line should be changed three times a year.

Mathematical Derivation of the Massometer Formulae

W = Weight of material being measured in pounds per second.
V_2 = Peripheral velocity of impeller in feet per second.
F = Reactive force in pounds.
N = Speed of impeller in revolutions per minute.
R = Radius of impeller in feet.
T = Torque or reactive force in foot pounds.
HP = Horsepower
M = Mass = W/g
Kinetic Energy = $(1/2)MV^2$

$$F = Ma$$
$$a = (V_2 - V_1)/t$$
$$V_1 = 0$$
$$F = (W/g)\ (V_2/t)$$
$$V_2 = 2\pi NR/60$$
$$T = FR = WNR^2/307.5 \quad (1)$$

Also

$$T = HP/0.00019N$$
$$HP = WN^2R^2/1.618 \times 10^6 \quad (2)$$

Equation (1) gives the reactive force resulting from the acceleration produced in the Massometer.

Equation (2) gives the horsepower required to operate the Massometer under varying conditions.

Scale Meter

A continuous weighing meter using an older principle is the Merchen scale meter shown in Fig. 5. This combines a high-capacity weigh-belt metering section with a sensitive pneumatic force balance which translates rate of flow into proportional air pressure. The output pressure is conveniently recorded and integrated by conventional pressure recorders calibrated in units of weight.

The material to be metered enters the inlet section from

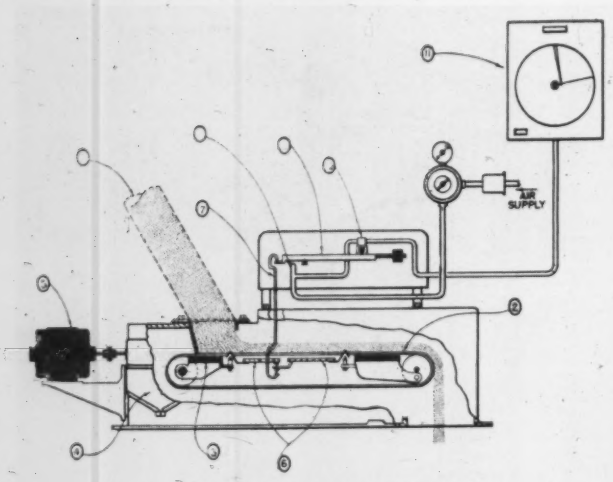


Fig. 5. Merchen Scale Meter.

an overhead chute (1) and is deposited on the weigh belt (2) over the rear deck (3). The weigh belt is driven at a constant speed, as determined by change gears in the gear box (4), by a synchronous motor (5). The material is then carried over the weighing platforms (6) on the weigh belt. As the material passes over the weighing platforms, its weight is transmitted through a yoke (7) to the scale beam (8). Variations in the weight of material deflect the beam above or below the balanced position. This movement of the scale beam operates a "flapper and nozzle" pneumatic relay (9) which regulates the air pressure acting upon the piston (10). The air pressure acting upon the piston restores the scale beam to proper balance and at the same time positions the pen on the recorder (11) to record rate of flow. The pen position is integrated to totalize the flow. After the material passes over the weighing platforms, it crosses the front stationary deck before being discharged downward. The scale meter is built with either a 9- or 18-inch wide belt, with capacities of 10 and 60 cubic feet per minute respectively. The accuracy is 1 percent from 100 to 10 percent of capacity. By changing belt speeds the capacity may be reduced to as little as 1/60 of maximum.

Scale Feeder

Fig. 6 shows a continuous weighing feeder which also operates on the weigh-belt principle. The metering section is the same as in the scale meter, including the force balance; the deflections of the scale beam actuate magnetic mercury switches which energize the electric clutch controlling the position of a motorized gate in the feed section. The poise weight on the beam is set to deliver the desired rate of feed by weight. Any deviation in weight is detected by the scale beam and the gate opening is automatically adjusted so that a uniform rate of feed is maintained. The rate of feed is maintained within 1 percent over periods of time as short as one minute because the weigh-belt speed is constant, the weighing platform has low inertia, and there is a minimum lag between the detection of unbalance and correction in the feed section, interference with the gate operation by foreign material, or derangement of the weighing section. Features include:

1. The weighing platform is only 15 inches long and weighs only a small amount of material on the belt. Since the sensitivity of the scale is a percentage of the total weighing capacity, the Merchen scale with small capacity is capable of detecting extremely small changes in weight and will still handle a large volume of material.

2. The feed gate is not operated directly by the scale lever system but by a motor, and the full sensitivity of the beam is utilized to detect changes in weight.

3. A synchronous-speed motor drives the weigh belt at a constant speed, independent of voltage or load variations, providing accurate control and integration of the amount of the material fed.

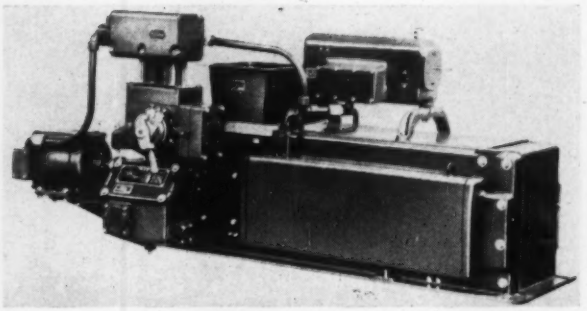


Fig. 6. Merchen Scale Feeder.

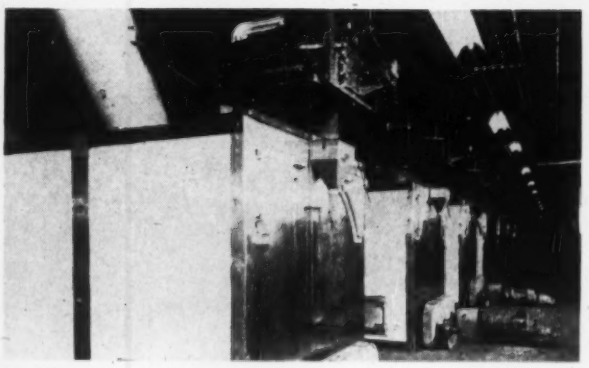


Fig. 7. Installation of Merchen Feeders ahead of roasting ovens.

Applications of Meters and Feeders

Scale meters and Massometers have three general applications in industrial processing—(1) materials accounting on a continuous basis, (2) metering material being loaded or unloaded in bulk, and making inventory records when material is transferred from one process to another, and (3) for batch control where it is necessary to add a definite amount of an ingredient to a process. Here the instrument can be preset to deliver the predetermined amount and, when the integrator totals this amount, the meter is automatically stopped. Control to 1 percent is obtainable. The scale meter and Massometer may also be used as proportioning controllers. In this application, the instrument accurately meters the flow of material and the pneumatic output feeders or regulators to proportion the flow of other ingredients to the main stream.

Typical Installations

To date, Massometers have been installed only in flour mills. The average mill requires from 6 to 12 Massometers to give a complete graphic story of the flow through the various stages of refinement and extraction. It is very important in flour milling to obtain as large a yield as possi-

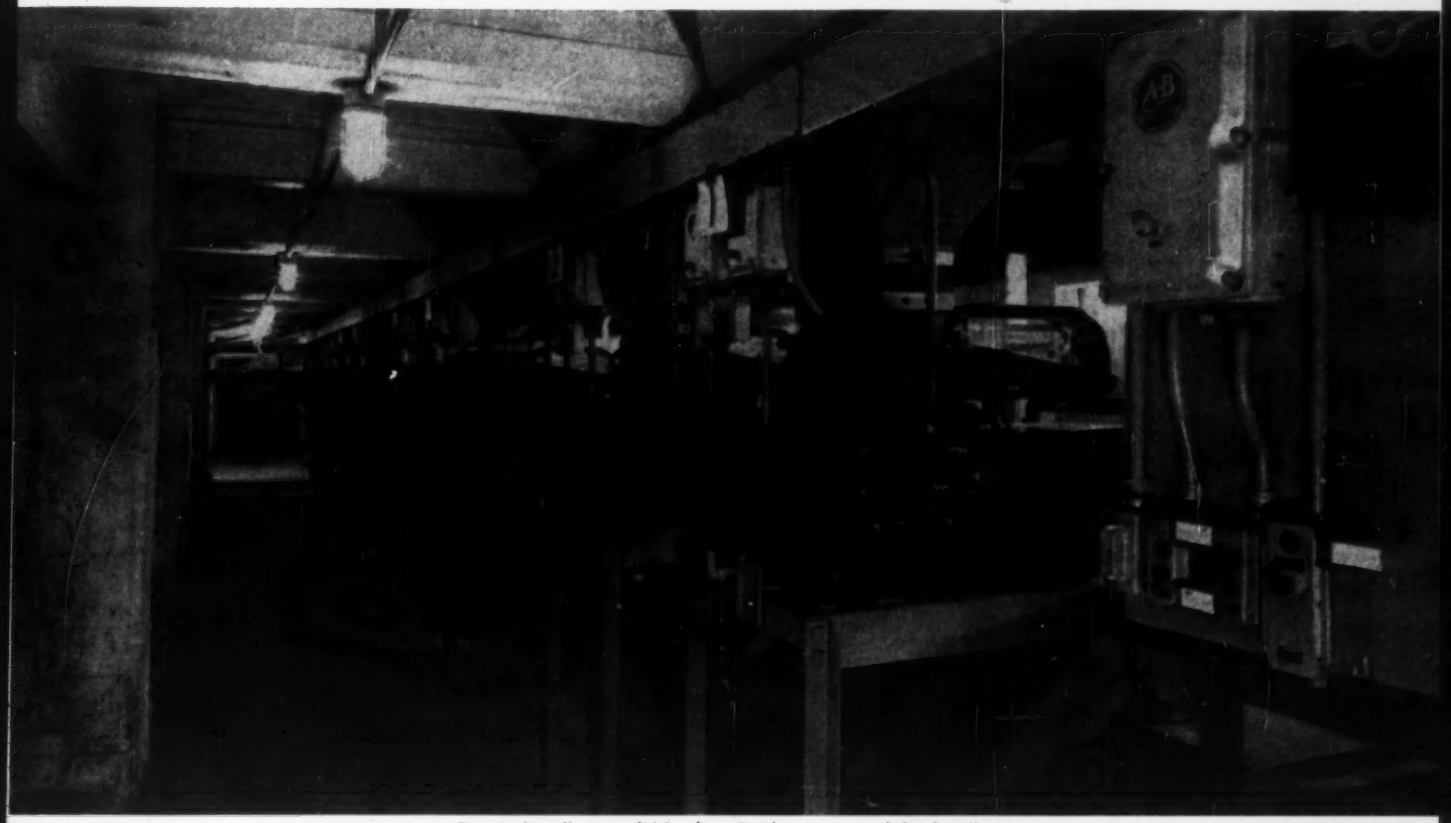


Fig. 8. Installation of Merchen Feeders in animal feed mill.

ble of the more valuable products. It is also important to work the roll stands uniformly. The Massometer aids in doing both of these jobs exceptionally well. Millers at first refused to believe that variations in flow as large as those recorded could exist. Subsequent adjustments on the milling machinery corrected these conditions.

The Massometer also serves as a valuable sensing element where breakdowns occur that are not obvious on the surface. Such a breakdown could be the failure of an elevator, the choking up of a sifter, or even an empty supply bin. Ordinarily, these mishaps are not detected until the mill is badly choked up and flour, along with its by-products, are piling up on the floor. This warning can be given by means of high- and low-limit switches located in the recorded pressure line.

In one food plant the roasting of a raw product was critical. To prevent waste due to excess roasting, the ovens were operating below capacity and, to meet production schedules, the installation of an additional oven was contemplated. Then it was decided to install Merchen gravimetric feeders to maintain a uniform rate of feed so that the ovens could be operated at optimum capacity without danger of overroasting. Not only did the installation of Merchen feeders save the cost of a plant addition and new oven, but a more uniform product resulted. Note in Fig. 7 that the compact design of the feeders permitted installation near the ceiling without requiring extensive alterations.

An installation of 22 feeders for formulating a variety of animal feeds is shown in Fig. 8. Each feeder is supplied from any one of four storage bins not only to provide large capacity but also for flexibility since each bin may contain a different material.

Fig. 9 shows another food-plant installation of a scale meter where the instrument gives management a clear picture of the yield of a process by furnishing an accurate record of incoming raw material. Before the scale meter was installed, the material was measured by tallying the weight on the shipping tag of each bag of material. After the scale meter was installed, the bag totals were found to exceed the scale meter total by nearly 5 tons in a 16-hour run of 135 tons of material. The difference was due to the fact that the material when bagged had a high water content which dried out during storage. Now the yield of the process is computed from actual weight of the material as it enters the process. An additional benefit of the scale-meter installation is a more uniform flow of material to the process. At this plant, the material is unloaded by manual labor and the recorder immediately shows any decrease in flow due to the absence of unloaders from their station.

It can be seen that there are available accurate flowmeters and controllers for handling free-flowing solid materials. These continuous weighing instruments are capable of solving many problems encountered in continuous processing.

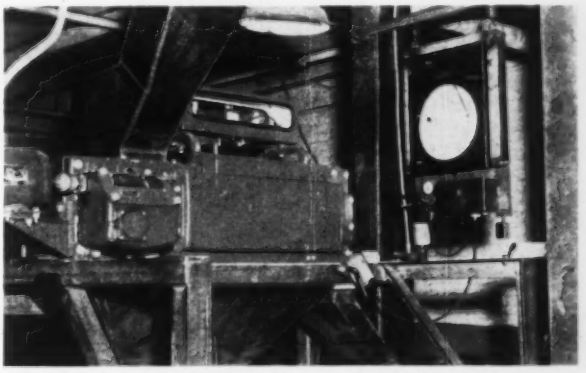


Fig. 9. Installation of Merchen Scale Meter for material accounting.

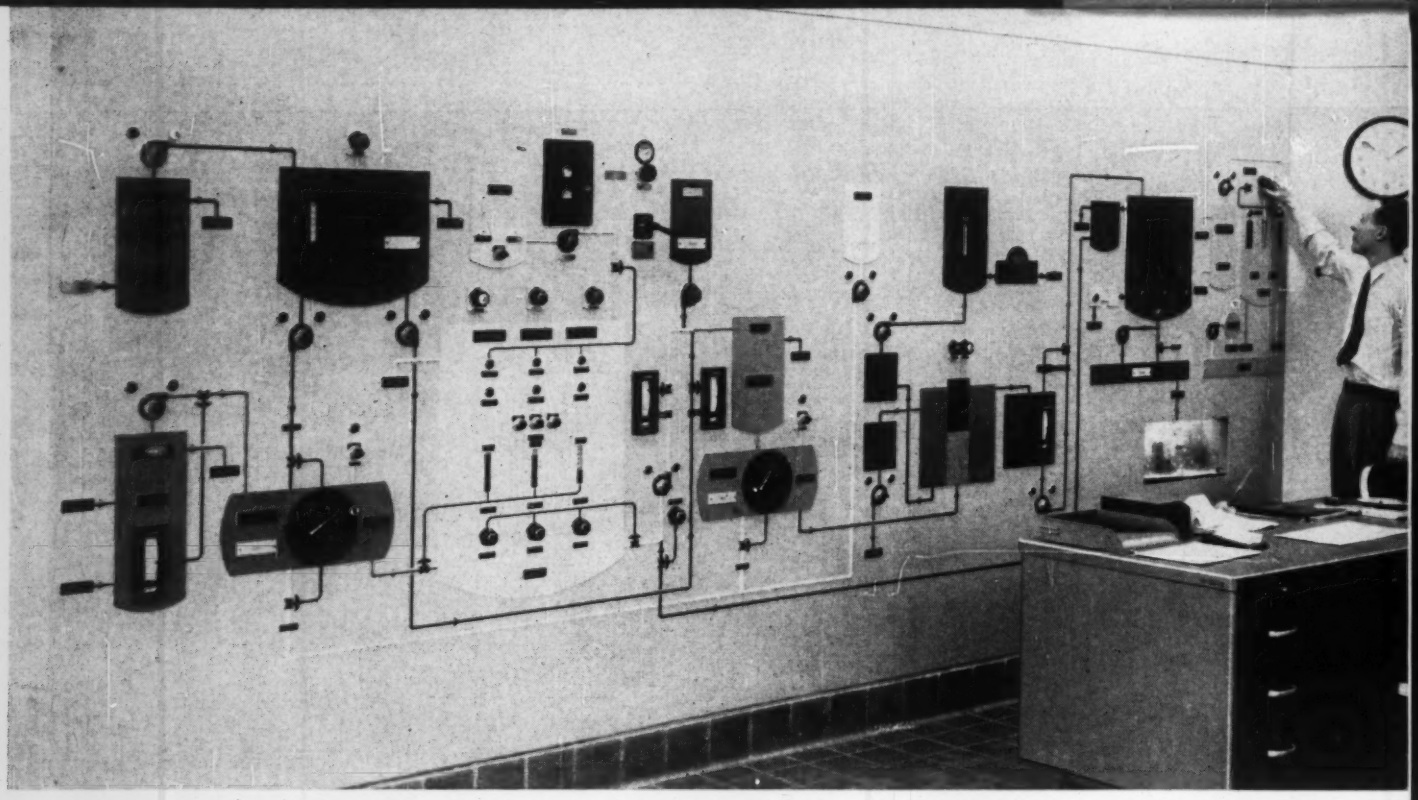


Fig. 1. The graphic panel (left) and instrument panel at right of graphic panel. Top row of instrument panel contains (left to right) Beckman pH 6-pt. amplifier, Brown pH recorder/controller to control pH of incoming raw alkali waste, Brown pH recorder/controller to adjust pH to 8.5 to neutralize acid waste

A graphic-panel centralized-control

Careful analysis of the waste-treatment problem of an industrial plating operation proved that complete quality control was essential, and led to the installation of a $100,000 graphic-panel control system. The analysis, design factors, and instrumentation are presented.

JOHN MADDEN
Oneida Ltd.

WHILE the flow sheet for the Oneida Ltd. waste-treatment plant was being developed, no plans were made for installation of a graphic panel. The original flow-rate and analysis data, taken over several months, had indicated that there would not be excessive variation either in flow rates or in toxic content of the waste to be treated. Had this proven to be true, manual operations throughout most of the treating cycle would have been practical.

However, the analysis of the problem was continued for a period of 18 months, so that before the plant was designed and constructed a picture was obtained of better than a full-year's operations. Curves of the varying flow rates, of the varying cyanides and metals contents, and of acid concentrations showed that the treating problem was complicated.

Factory Waste

The factory wastes from the plant are of three categories—(1) silver-bearing cyanides, (2) acids made up mostly of very dilute hydrochloric, sulphuric, and nitric acid, and (3) what was termed alkali waste, but which actually consisted of everything which was not either silver bearing or which did not contain acid. The alkali wastes consisted of a variation of 38 different solutions, in many concentrations and combinations—principally soaps, detergents and various cleaners, kerosene and oils, some cyanides and metals, and a variety of smaller concentrations of other materials used in plating.

The operation of the Oneida Ltd. plating line consists of approximately 110 running rinses from washing, bright dip, and plating, and approximately 130 still rinses and baths. These still rinses were discharged to the waste-treatment plant, some daily, some bi-weekly, some monthly, and a few twice a year.

The flow rates for alkali wastes were found to be nearly constant on a weekly basis, but were not constant on a daily basis. Likewise, although the flow rate of alkali waste was extended over a 20-hour day, the flow rate of the acid waste which was to be used in treating the alkalies was delivered principally during an 8-hour period

Presented at 2nd Annual Conference on Instrumentation in Water, Sewage and Industrial Waste Treatment, April 20, 1954, Manhattan College, N. Y.

and separate sludge. Bottom row (left to right): 6-pt. automatic switch for Beckman amplifier; 3-point Foxboro level indicator for level of oxidation tanks; Foxboro level recorder for levels of the two silver recovery tanks; Foxboro flowmeter recorder for recording flow rate of conditioned discharge.

WASTE-TREATMENT PLANT

each day. The flow rates of silver-bearing cyanides were so unpredictable that no attempt has been made to set up an hourly flow rate, but rather has been taken on a weekly basis. These flow rates generally amounted to 200,000 gal./day of alkalies, 40,000 gal./day of acid, and 25,000 gal./wk. of silver-bearing cyanides.

The toxic content of the alkali waste has been found to vary from 8 to 92 parts per million at various times; even though 20 million gallons of alkali waste have been treated in 80,000-gallon batches since the first of January, 1954, the toxic concentration of no two of these batches has ever been the same.

Stream Factors

Our problem is further complicated by the public stream into which the treated waste is being discharged. The flow rate from the waste-treatment plant generally averages about 250,000 gal./day. This is mixed with another 750,000 gal./day of what is termed "clean factory waste." This total of one million gallons per day then is discharged into the public stream, which has a minimum flow rate of approximately 4 million gallons per day, giving us a dilution factor of only 4 to 1 over factory discharge, or 16 to 1 over waste-treatment plant discharge. For this reason it is essential that the quality of the waste-treatment-plant effluent be maintained at a high level that is not more than 0.5 part per million of cyanide and not more than 1 part per million of total metals.

Design Basis

It was necessary, therefore, to design the Oneida Ltd. waste-treatment plant on quality of effluent, and to consider extensive instrumentation toward the end of guaranteeing this quality.

A graphic panel, including installation, would amount to approximately $100,000, and would replace two operators who would otherwise be necessary. This did not appear at first to be economically feasible. However, the factor of maintaining high-quality effluent was overruling, and the graphic panel was installed.

The Treatment Plant

This waste-treatment process (Fig. 2) starts with three waste-collection sumps (acid, alkali, and silver-cyanide) which were located so that all factory wastes in the three categories could be collected by gravity flow from the various manufacturing areas.

Alkali Waste

The alkali waste is transferred to three 80,000-gal. cyanide oxidation tanks; while one tank is being filled a second may be treated and a third may be transferred. After cyanide oxidation, the operation is a continuous flow, including a skimmer (for removal of soaps, oils, and fats), a pH-adjustment tank for neutralizing after skimming, a thickener for removal of floc, and gravity

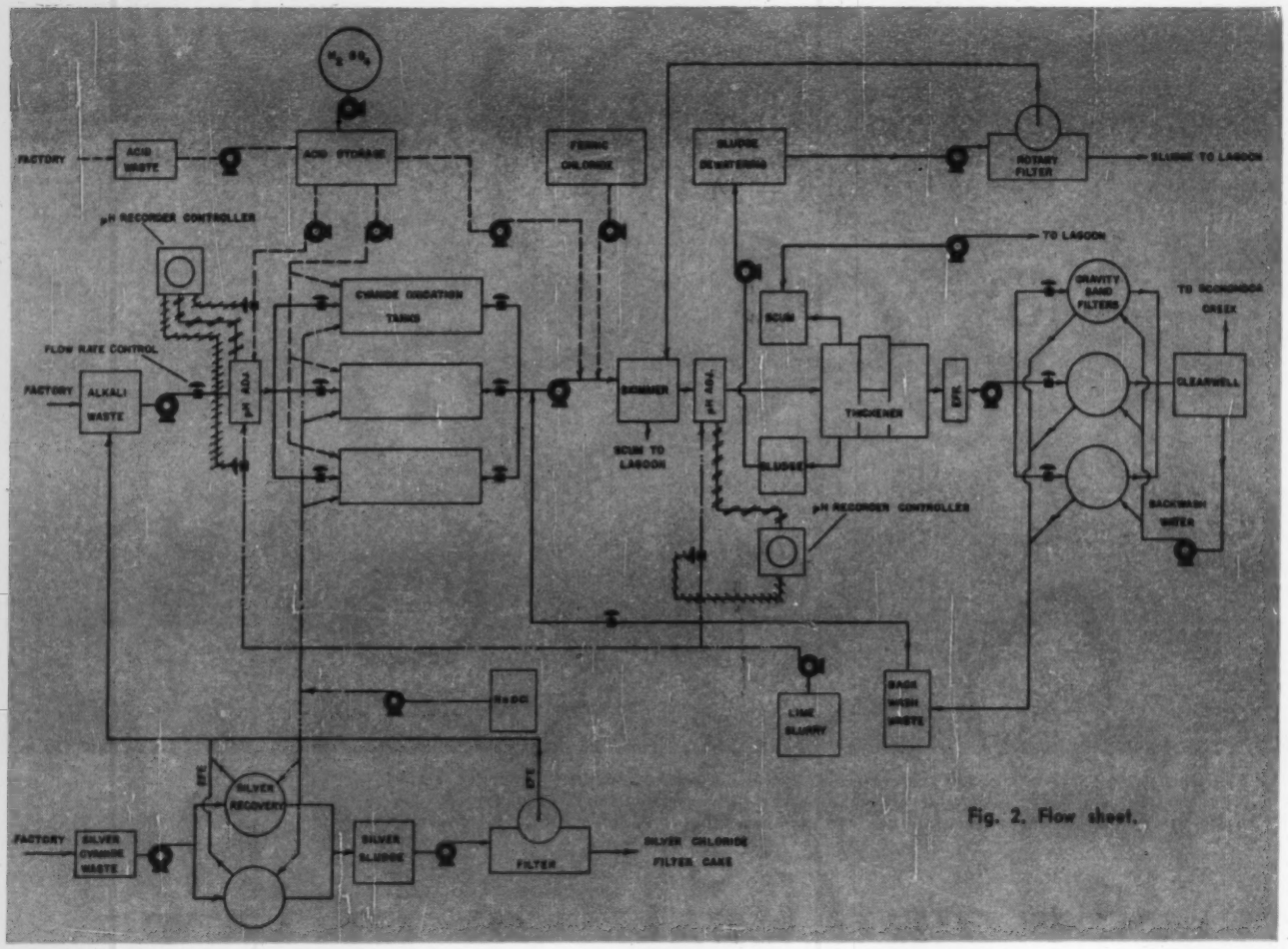


Fig. 2. Flow sheet.

sand filters for what is termed a polishing operation for the removal of any fine, suspended matter that is not discharged in the thickener.

The acid collection sump acts as an intermediate point from where the acid is transferred to a 50,000-gal. storage tank for the double purpose of providing an acid supply for treating the alkali waste, and to provide for equalization of the acid because the concentration of acid discharged from the factory throughout the day varies considerably in both acid concentration and metals content.

Silver Waste

The silver-cyanide waste sump also acts as an intermediate point, and the silver-bearing cyanides are transferred alternately to two 12,000-gal. silver-recovery tanks. No attempt is made in these recovery tanks to completely oxidize the cyanides; the purpose is to treat the potassium silver cyanide with sodium hypochlorite, reducing the silver to silver chloride, which may be first settled as a sludge in the silver recovery tank, and in a following operation washed with acid to remove metals other than silver. The resulting slurry is then filtered to produce a dry filter cake for further refining by electrolysis.

Instrumentation

The level of the alkali sump is transmitted by an air-bubbler pneumatic transmitter to a blind "Rotax" controller located adjacent to the motor starters for the alkali transfer pumps. This "Rotax" controller provides for starting and stopping of the two pumps, complete with back-up and high-level alarm provided by a "Unalarm" mounted in the diagram of the graphic panel. Also mounted in the diagram is a "Model 52" indicating proportional level controller whose index may be set manually. A d/p cell at the sump transmits the level measurement through the "Model 52" controller to an air-motor valve located in the line from the sump to the pH-adjustment tank. This maintains a predetermined liquid level in the alkali sump.

The pH-adjustment tank is between the alkali sump and the three oxidation tanks. This tank and equipment provides means for adjusting the pH of the raw alkali waste (which varies from pH 6.5 to 12) to a controlled range of pH 9 to 10.5. Acid from the acid storage tank and lime slurry from a supply tank are provided as the pH-adjusting media.

Beckman electrodes and an amplifier are used to measure the adjusted waste sample, and a Brown recorder-controller (with proportional and reset) controls the operation of acid or lime slurry addition. The Brown instrument is mounted on the instrument panel (Fig. 2); the Beckman equipment is mounted locally at the pH-adjustment tank (Fig. 4).

Oxidation-tank Control

The cyanide-oxidation tanks provide a storage for 80,000 gallons of alkali waste whose pH factor has been adjusted, and which then may be treated batch-wise by the injection of sodium hypochlorite for the oxidation of cyanide to CO_2 and nitrogen.

In order to eliminate as much manual operation as possible, an interlock system has been provided in the graphic panel for filling, treating, and emptying these oxidation tanks. When the tank being filled reaches a preset high point as set on a level indicator located in the

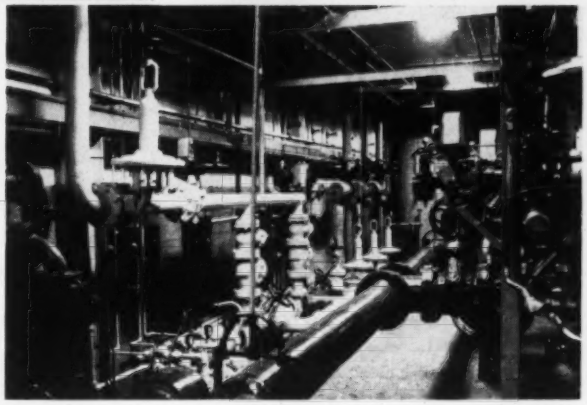


Fig. 3. Automatic valve control station for filling and emptying cyanide oxidation tanks. Foxboro butterfly valves with pneumatic operators and Foxboro d/p cells for liquid-level measurement are shown.

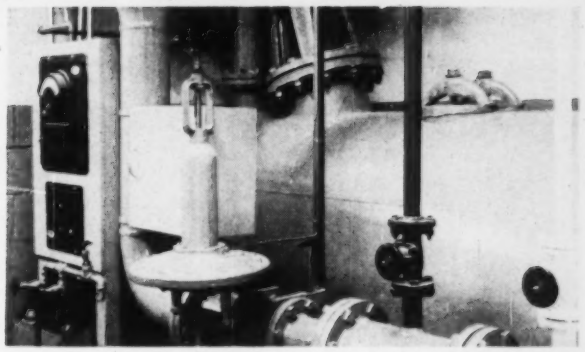


Fig 4. Flow rate control and pH adjustment tank. Sample from tank in background goes to Beckman pH system; Foxboro butterfly valves control flow rate of incoming raw alkali waste for treatment. White vertical pipe at right is lime slurry; darker pipe is acid used for raising or lowering pH as required.

graphic panel, the inlet valve to that tank automatically closes and the next tank in sequence begins to fill. If this tank is already full, the third tank is automatically chosen. Should the three tanks be filled, no inlet valve will open until a tank is emptied.

The injection of sodium hydrochlorite is so set up that the number of gallons required may be selected on an indicating gage located in the graphic panel. The tank to be treated may be selected by a selector switch also in the graphic panel, and the correct number of gallons will be injected under automatic control after manual initiation of the cycle. When it is necessary to empty a tank, the interlock system is such that the outlet valve cannot be opened until the sodium-hydrochlorite injection has been completed.

To choose the correct tank to be emptied, the operator must initiate a start-stop switch in the graphic panel. The action opens the correct outlet valve, starts the transfer pumps, and starts the acid-transfer pump to introduce a correct predetermined proportion of acid to the treated alkali waste. The interlock system is such that no inlet valve can be opened while an outlet valve is in operation; nor, conversely, can an outlet valve be operated while a tank is being filled. Similarly, neither an inlet nor an outlet valve can be operated while a tank is being treated with sodium hydrochlorite.

The level of both the acid-waste collection and the silver-cyanide waste-collection sumps are measured by air bubblers to blind "Rotax" controllers located adjacent to the motor starters for each sump. These "Rotax" controllers start and stop the two pumps, complete with back-up and high-level alarm.

Thickener

A second pH-adjustment tank is located in the gravity flow line from the skimmer tank to the thickener. This tank readjusts the pH of the treated waste (which has been reduced to a pH of 3 by the addition of acid during the transfer from the oxidation tanks to the skimmer). The pH of this liquid is adjusted to 8.5 by lime slurry addition under control of a Brown recorder-controller mounted in the instrument panel, which in turn receives its signal from a Beckman amplifier and electrodes locally mounted at the pH-adjustment tank.

The pH of the treated alkali-acid waste having been adjusted to 8.5, it is passed through a thickener (an "Infilco Cyclator" 35 ft. in diameter with a 11-ft. sidewall depth) providing for a flow rate of 350 gal. per minute. The three physical components of the alkali-acid waste are thereby separated into sludge, scum, and relatively clear effluent, collected in three separate sumps for disposition to a sludge dewatering tank, the lagoon (for scum), and gravity sand filters (for the clear effluent). "Rotax" level controllers control the liquid flow through these three sumps.

A Foxboro flow-rate controller has been provided for de-sludging the thickener on a basis proportional to the total flow rate through the thickener. The sludge and scum are removed from the collection sumps on a high-low level-controlled operation, while the clear effluent is removed under a constant-flow control.

Sump Level Control

The levels of the three sumps are measured by an air purge instrument on each and are transmitted to locally-mounted controllers containing both contacts for starting and stopping the pump motors and high-level alarm lights on the graphic panel.

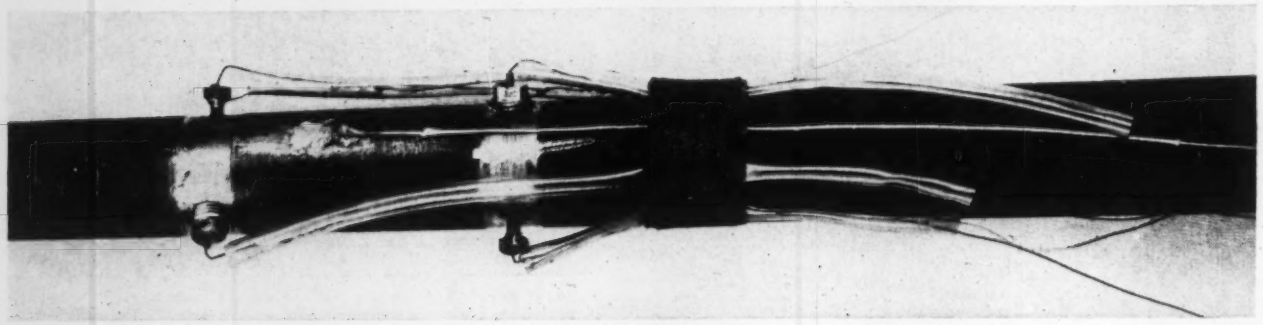
A pneumatic proportioned level-controller (a d/p cell) locally mounted with a "Model 52 Foxboro Consotrol" proportioning controller in the graphic panel, maintains the level in the effluent sump within set limits. Control valves in the effluent lines to the three gravity sand filters maintain the level in the effluent sump, and equally divide the flow rate between the three filters or, at times, between two of the three filters. This latter operation is performed by three "Model 59" proportioning controllers mounted on the three flow-control valves.

The levels of the three filters are measured by air bubbler and transmitted by a d/p cell to a Foxboro "Model 58" controller located in the rear of the graphic panel. Controlled air pressure is in turn transmitted to the three effluent valves which control the rate of flow from the filters, based on the liquid-level measurement in the filters in such a manner as to maintain a discharge from the filter equal to the rate of flow into the filter.

A d/p cell measures the loss of head across each filter; as the loss of head reaches a certain preset measurement a pressure switch on the rear of the panel initiates a high-loss-of-head alarm. These pressure switches also initiate the automatic back-wash cycle.

The plant operates on a 24 hr./day, 7 day/week schedule, although the flow rate from 2 a. m. to 7 a. m. weekdays and all of Saturday and Sunday is low. Operators are in attendance, one man per shift, from 8 a.m. to 11 p.m., with one maintenance mechanic on hand from 8 a.m. to 5 p.m. The filling, skimming, sludging, and filtering cycles are all under automatic control, together with the pH adjustment, and operate unattended.

In addition to the instruments and equipment used for handling the raw and treated wastes, an Omega "Universal Feeder" is used to maintain the supply of 5-percent lime slurry, and a Wallace and Tiernan Chlorinator is used for manufacturing the necessary sodium hypochlorite.



Thermocouples in gun barrel. The two smaller units are the bore-surface thermocouples; other two are in-wall thermocouples.

Measurement of

GUN BARREL TEMPERATURES

METHODS for measuring transient temperatures in machine gun barrels have been reported[1,2]. One of these methods[1] has been improved so that simultaneous recordings of temperature at a number of points on the bore surface and in-the-wall of gun barrels are now possible while the gun is being fired.

Thermocouples

Fig. 1 shows the two bore-surface and the two in-wall thermocouples. The thermocouple elements for bore-surface temperatures were constructed as in Fig. 2. A #24 constantan wire (dia. 0.0201 in.) was oxidized at bright red heat in air by passing a current of about 10 amperes through it. An externally threaded steel plug was made from gun-barrel steel, and a 0.0225-inch-diameter hole was drilled axially through the plug. The oxidized wire and the hole in the plug were both coated with a thin mixture of Sauereisen cement #29 and the wire then threaded through the hole. The oxide coating served to insulate electrically the wire from the plug. The Sauereisen cement was both a cement and an electrical insulator. After the cement had set and dried the assembly was sufficiently rugged to withstand the shock and pressures developed during firing. When the cement had dried the whole assembly was annealed at a temperature of about 1000 deg. F. The plug then was set in a polishing jig and the constantan wire ground and polished off flush with the bottom surface of the plug. The electrical resistance from the wire to the plug was approximately one megohm after the polishing.

The plug then was coated with a quick-drying cement, except on the polished end, and placed in an iron plating bath prepared according to the MacFayden formula[3]. The wire (A) and plug were connected to the negative side of a 6-volt storage battery, and a coil of iron thermocouple wire was used as an anode. About 0.001 in. of iron was plated on the end of the plug in order to bridge the insulation between the wire and plug. Thus the thermocouple hot junction was the interface between the end of the constantan wire and the layer of electroplated iron. After the plating operation the assembly was annealed again at 1000 deg. F.

A study was made in order to be certain that the electrolyte had not penetrated the insulating cement and short circuited the plug and wire at some points other than at the end. The deposited layer of iron was ground off several thermocouples; each time, the electrical resistance returned to the initial high value, indicating the only junction was at the interface between the wire and the plated layer of iron. The iron-vs.-Constantan thermocouple made in the manner described and calibrated against the transition points of water, $Na_2SO_4.10H_2O$, and lead, varied from the Leeds and Northrup standard conversion tables by less than 0.7 percent.

The thermocouples used for measuring in-wall temperatures were constructed as in Fig. 3. A #24 Constantan wire was oxidized and cemented into a plug, then ground and polished flush with the bottom end of the plug and annealed. Plating was not used on this thermocouple. The hot

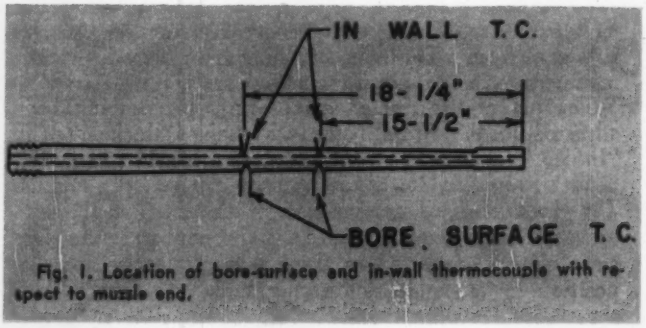


Fig. 1. Location of bore-surface and in-wall thermocouple with respect to muzzle end.

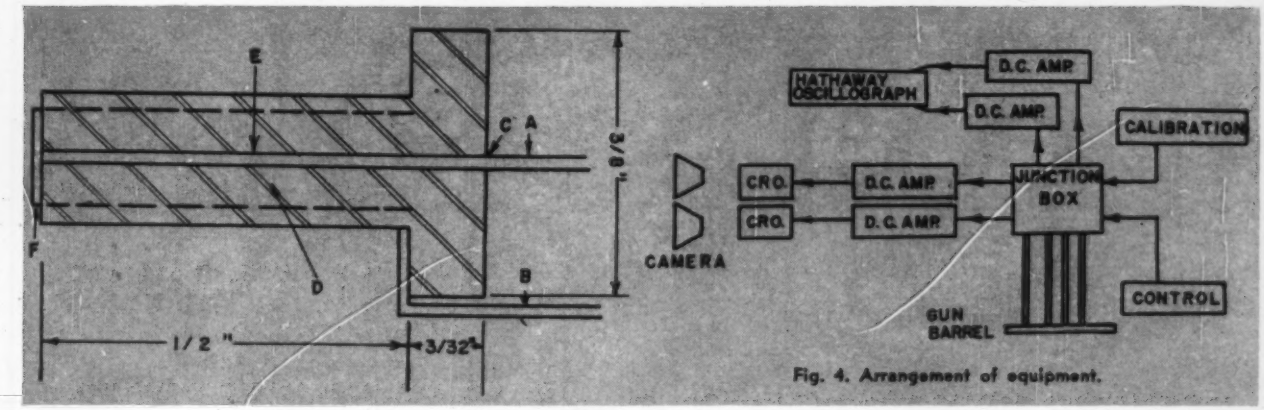


Fig. 4. Arrangement of equipment.

Fig. 2. Bore-surface thermocouple. A is oxidized #24 Constantan wire; B is #28 iron wire; C is hole drilled with #74 drill; D is barrel steel body; E is layer of refractory cement; F is 0.00103-in. layer of electroplated iron.

B. T. WILLMAN, J. E. BROCK, W. L. SIBBITT and G. A. HAWKINS

Purdue University

A method has been developed for simultaneously measuring temperatures at numerous positions on the bore surface and in the barrel wall of an automatic gun during firing. The construction of sensitive thermocouples which were sufficiently rugged for this application is described. An accurate knowledge of these temperatures is of importance in barrel life studies, thermal stress analyses, and heat-transfer investigations.

junction was formed when the plug was seated firmly in a flat-bottomed hole in the barrel wall. The plug was held in firm contact with the bottom of the hole by a holding nut screwed into the barrel and pressing against the shoulder on the plug. An ohmmeter was used to indicate when the constantan wire was seated in the well; at contact with the bottom of the well, the electrical resistance (wire to barrel) dropped suddenly to a low value.

Recording Equipment

For measurements at the bore surface, each of the bore temperature thermocouples was connected to a separate d-c. amplifier (Fig. 4) from which the amplified signal was fed to the vertical deflection plates of a DuMont "Type 247" cathode-ray oscilloscope. The deflection sensitivity was about 0.01 volt per inch on the vertical axis. Subsequently, DuMont "Type 322" dual-beam oscilloscopes were used without the external d-c. amplifiers. Any lack of linearity in the amplifier response characteristics was compensated for by calibration at several points over the anticipated voltage range just before and immediately after the recording—if it was considered necessary.

Rotary-drum cameras with f/4.5 lenses (one for each oscilloscope window) were used to photograph the temperature traces. The oscilloscopes had short-persistence blue screens. A manual calibration circuit was used to impress ten known voltages on the d-c. amplifiers just prior to making a temperature recording. Auxiliary electronic circuits were used to correlate the temperature record with the instant of firing of the gun, the opening of the camera shutters, and to put timing marks on the record.

A twelve-channel Hathaway oscillograph recorder "Type MCR 15" was used to record the in-wall temperatures. Each of the in-wall thermocouples was connected also to a d-c. amplifier and thence to the proper recording channel in the Hathaway recorder. A voltage-divider circuit with a constant-voltage source was used to calibrate the temperature records in the same manner as described for the bore temperature records.

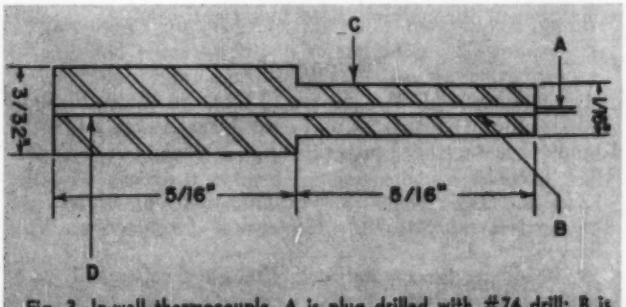


Fig. 3. In-wall thermocouple. A is plug drilled with #74 drill; B is #24 oxidized constantan wire; C is thermocouple body, barrel steel; D is 0.0012-in. layer of refractory cement.

Data

The positions of the bore-surface thermocouples with reference to the muzzle end of the machine-gun barrel were as shown in Fig. 1. These thermocouples were located back of the grooves. The bore surface was subjected to pressures of the order of 50,000 psi., and to the hot gases which approached temperatures of about 5,000 deg. F. The turning bands on the projectiles passed directly over the surfaces of the grooves and lands. During firing the bore surfaces sometimes were covered with particles from the turning bands and with residues from the products of combustion. Consequently the thermal resistance over the bore-surface thermocouples was not always constant. Therefore, some unusual temperature variations were observed in dirty barrels.

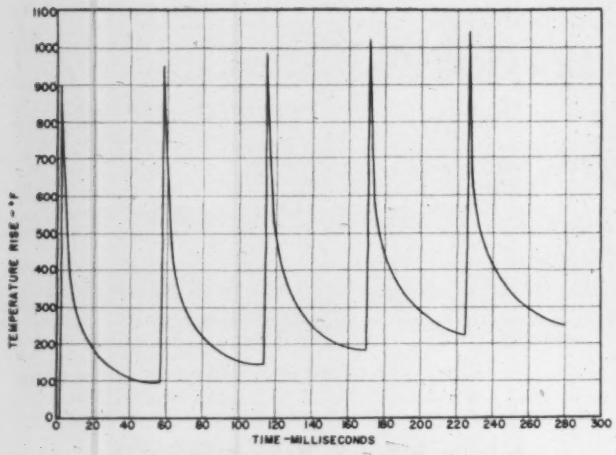


Fig. 5. Bore temperatures for a 5-round burst.

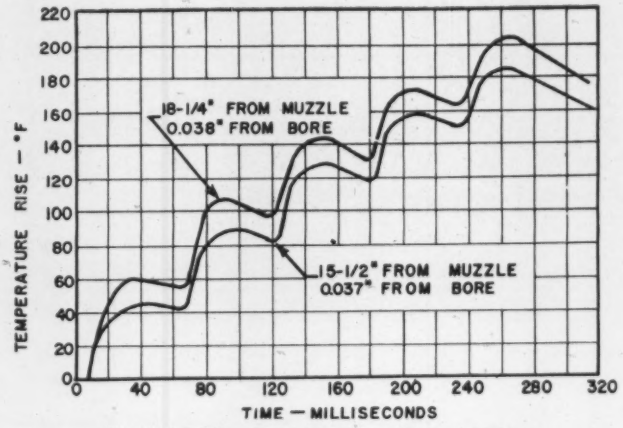


Fig. 6. In-wall temperature for a 5-round burst.

Table 1.—Average Maximum and Minimum Bore-Temperature Records (deg. F.) for a 5-round Burst. Caliber 0.50 barrel.

Round	18¼ *In. from Muzzle*		15½ *In. from Muzzle*	
	Av. Max.	Av. Min.	Av. Max	Av. Min.
1	915	153	846	95
2	996	185	915	145
3	1022	250	962	185
4	1038	310	992	275
5	1070	(325)	1032	(250)

Table 2.—Average Maximum and Minimum In-Wall Temperature Records (deg. F.) for a 5-round Burst. Caliber 0.50 barrel.

Round	18¼ *In. from Muzzle*		15½ *In. from Muzzle*	
	Av. Max.	Av. Min.	Av. Max	Av. Min.
1	60	48	46	40
2	108	96	92	82
3	145	130	130	117
4	173	163	168	148
5	205	185	185	170

Transient temperature records for a total of 50 rounds were made with these bore-surface thermocouples. Temperature records for continuous bursts of 5 rounds in a clean barrel were reproducible. Only minor temperature perturbations were observed on the records for continuous bursts of 25 rounds. Sometimes the thermocouples were "set-back" after a burst of more than 10 rounds. These thermocouples continued to function, but the position of the thermo-junction had shifted away from the bore surface.

Bore temperature records for a 5-round burst are shown in Fig. 5. A summary of the maximum and minimum bore temperatures is given in Table 1. The cyclic rate of fire was about 1050 rounds per minute. Time was measured from the instant of closing of the firing switch.

The data in Fig. 5 shows that a temperature gradient exists along the bore surface of a machine-gun barrel during firing; this gradient decreases as the number of rounds in the burst increases. An analysis of the temperature records in these experiments by the usual error method[4] showed a standard deviation for the maximum temperatures in Fig. 5 of about 50 deg. F., and for the minimum residual temperatures about 4 deg. F.

The in-wall thermocouples were located at points 18¼ and 15½ inches from the muzzle end of the machine-gun barrel. After the data were obtained the barrel was sectioned and the location of the thermocouples was determined. The thermo-junction at 18¼ inches from the muzzle was 0.038 inch from the bore surface, and the junction at 15½ inches was 0.037 inch from the bore surface. The in-wall thermocouples were not damaged by long bursts of continuous firing.

Average maximum and minimum temperatures recorded by these thermocouples are shown in Fig. 6 and in Table 2. A noticeable rounding off of the peaks and troughs of the temperature waves occurred due to damping of the transient. Maximum and minimum temperatures occurred at slightly later times for these recordings because of the difference in thermal resistance.

Errors are probably present in all of these data because the presence of the thermocouple element produced anisotropy in both radial and axial directions in the barrel wall. The influence of this anisotropy increases with the number of rounds fired in a burst. The degree of anisotropy also increases with the number of thermocouples mounted in the barrel wall.

The number of locations to be monitored is not limited by the recording instruments but by the degree of modification of the gun barrel. These limitations may be due to either structural strength requirements or to altering the homogeneity of the gun-barrel wall.

Acknowledgments

The authors express appreciation to personnel at the Office of the Chief of Ordnance (Small Arms Development Division) Washington, D. C., and at Springfield Armory, Springfield, Massachusetts for continued interest and encouragement throughout these investigations.

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Socony-Vacuum uses the modern way to design new plants and investigate new processes—with a digital computer. At left, Miss Ann Tierney, lab technician, and T. W. Nelson, laboratory director, test the digital computer installed by Socony-Vacuum. At right, computer is checked out by engineer L. L. Gainey.

Refinery Uses Digital Computer

RESEARCH SCIENTISTS of Socony-Vacuum Oil Company, Inc. will soon put a high-speed electronic digital computer to work figuring out how to set the valves and fire the stills in an oil refinery to achieve most efficient operating conditions. The machine, called Mobilac, is now being installed at Socony-Vacuum's Research and Development Laboratories at Paulsboro, N. J.

Mobilac is believed to be the largest and fastest computer installed by any oil company. It replaces one which has been in service at the Paulsboro laboratories for several years.

A twin of Mobilac will be installed early next year at the Field Research Laboratories of Socony-Vacuum's affiliate in the Southwest, Magnolia Petroleum Company, Dallas, Tex., where it will be put to work solving problems relating to crude-oil exploration and production.

The program for determining most efficient refinery operating conditions, one of the first undertaken in the oil industry, will be carried on in cooperation with the staff of Socony-Vacuum's refinery at Paulsboro.

To conduct the program, the laboratory scientists have constructed a mathematical model of the Paulsboro refinery, using numbers and formulae to represent processing units.

The model consists essentially of a group of about 100 equations which express mathematically the behavior of catalytic cracking, reforming, and other processing and blending units at the refinery. These equations are punched on cards, which are read by Mobilac and stored in its memory.

Next, additional punch-cards containing data on crude oil characteristics, available charge stocks, motor gasoline specifications, product commitments, and other operating conditions and requirements are fed into the computer. Mobilac will then add, subtract, multiply, and divide these factors in the proper way and come up with answers in as little as 15 minutes.

To do Mobilac's computations with hand calculators would require simultaneous operations of 250 to 300 calculators. Mobilac can solve problems in algebra, calculus, or logic. It can add or subtract 500 ten-digit numbers a second, multiply 120 a second, and divide 85 a second. It has a good memory—good enough to remember more than 4,000 ten-digit numbers. It can make choices or decisions based on the results of its calculations.

According to William M. Holaday, director of Socony-Vacuum laboratories:

"We expect Mobilac will open up many new avenues for petroleum research as well as new possibilities in the company's production, manufacturing, and distribution operations.

"In the field of production, we plan to use it to develop improved methods of recovering crude oil and natural gas from underground reservoirs.

"Among the other areas in which it has potential uses are refining process development, catalyst research, reactor design, crude-oil analysis, and gasoline blending.

"For instance, in combination with a mass spectrometer (for identifying the molecular structure of hydrocarbons), the high-speed computer will enable us to make more rapid and much more detailed analyses of crude oil, lubricating oil stocks, and waxes than any presently used analytical tools. This in turn may make possible further improvements in the quality of lubricating oils and waxes."

Both of the new computers ordered by Socony-Vacuum laboratories are manufactured by the ElectroData Corporation of Pasadena, Calif., an affiliate of Consolidated Engineering Corporation.

The Automatic Factory—
A Critical Examination

Economic factors transcend all others in deciding how automatic a production process should be. Here, for the first time, are eleven case studies of the actual costs of conventional vs. more automatic methods of production.

STEPHEN A. JUNE
JOHN D. BARDIS
LEE H. LURIO
LEONARD S. POLANER
OYSTEIN SAGEDAHL
HERBERT A. SKLENAR
BERNARD K. YENKIN

VI. COSTS

NO BUSINESSMAN would invest in new equipment without considering specific *cost data*. Yet, much has been written in various publications on automation without giving due emphasis to this important aspect. Every businessman who is interested in installing automatic equipment to replace conventional equipment wants information on (1) required investment, (2) potential operation savings, and (3) payoff, or amortization, period.

However, when executives were approached for such information, one obstacle became evident: management preferred to talk in general rather than specific terms. As one manufacturer stated: "We cannot give you data on our actual savings because we would then lose much of our competitive advantage. Our competitors can install the same equipment as we have, but they will hesitate to do so before they know what savings have resulted in plants where the machines have been in use for some time. So the longer we can keep this to ourselves, the better off we are competitively."

Nevertheless, specific examples illustrating investment, savings, and payout periods have been gathered and are presented as case studies. Before going on to these cases, it is helpful to note how (1) obsolescence and (2) accounting procedures affect management's decision to invest in automatic equipment.

Payoff Period

In certain industries payoff periods must be relatively short. A good example is the automobile industry. Many parts become obsolete after one year; it is not economically advisable to install equipment that does not amortize itself in less than this time. Where year-to-year changes are so minor that they will not make the systems obsolete, longer amortization periods are permissable. Examples of such parts are press lines for body parts, and machining lines for engine and chassis parts.

The maximum payoff time allowed for companies using automatic equipment has been no greater than five years. In general the required payoff has been three years.

Accounting Procedures

In addition to use of somewhat arbitrary methods in selecting the payoff period, companies frequently fail to include certain cost changes in their calculations. For example, while the *direct labor savings* that result often are startling, *maintenance expenses* may increase to a point where the savings are offset.

Moreover, as a result of these changes in costs, administrative problems have arisen. Many companies budget indirect labor to departments as a percentage of direct labor. When automatic equipment causes direct labor savings, the indirect percentage will often rise above the budgeted allowance. Management often fails to realize this point. According to one machine manufacturer, the executives of a company which had installed a new transfer machine became dismayed by the rising indirect labor percentage that resulted. The department head concerned, under pressure from his superiors to reduce his indirect labor percentage, feared to utilize automatic equipment in future installations.

Cost Trends

Maintenance costs are being reduced as skill in automatic machine design is improving. On the other hand, engineering and installation costs will represent higher expenditures than in the past. As engineering departments now have to coordinate many elements (such as plant layout, processing, tool die design, material handling) and also work with the machine tool builders, careful planning and many design hours are necessary before construction can start.

This can be illustrated by a servomechanism used to control a process in an oil refinery. The $50,000 control unit paid for itself in three weeks; however, the short payoff period does not include the four years of costly development work by company engineers studying all the process variables to be considered in designing the servomechanism. Thus, one of the principal obstacles to be overcome before equipment is offered commercially is the high initial development cost.

The case studies that follow have been made available by the management of various industries. Some examples are more elaborate than others, but they all represent the actual results of automatic-equipment installations rather than the ideal hopes of machine designers and manufacturers.

Case Study 1
Automobile Cylinder Head

Operations performed: Machining of the four flat surfaces of the head on a two-way horizontal broaching machine.

Prepared for General Georges F. Doriot in partial fullfillment of the requirements of the manufacturing course at the Harvard Graduate School of Business Administration.

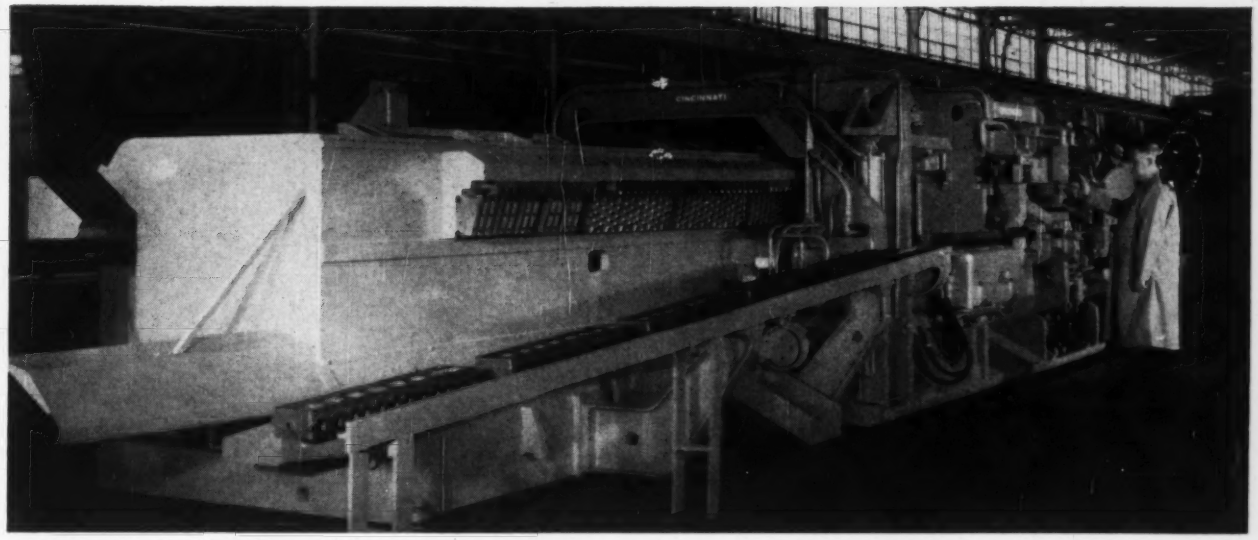


Fig. 6-1. Cincinnati 2-way horizontal broaching machine operates at broaching speeds up to 200 feet per minute. Cost factors for its use with cylinder heads are discussed in case study 1.

Source: Cincinnati Milling Machine Co.

In 1914 it took 162 machines to produce 108 pieces/hr.; *investment* was $243,000; *direct labor* per piece was 40 cents.

In 1949 it took 6 machines to produce 108 pieces/hr.; *investment* was less than slightly less than in 1914; *direct labor* per piece was 20 cents.

In 1954 it took 1 automatic machine to produce 108 pieces/hr.; *investment* was $230,000; *direct labor* per piece is less than 4 cents.

This data, tabulated in Table 1, shows that in forty years of declining money value the dollar investment remained about the same. However, by using automatic equipment the decrease in direct labor during the past five years almost equalled the decrease during the previous 35 years. Annual return on the new investment is 43 percent.

Table 1.—Costs for Machining 108 Cylinder Heads per Hour.

	No. of Machines	*Investment*	*Direct Labor (per piece)*
1914	162	$243,000	40 cents
1949	6	$240,000	20 cents
1954	1	$230,000	4 cents

Case Study 2
Axle Housing

Operations performed: Bore, face, drill, chamfer and tape on a transfer machine (Figs. 6-2 and 6-3).

Source: The Cross Co.

In this installation, 5 machines were replaced in 1952 by 1 transfer machine. The original costs of the replaced equipment were:

Machine #1:	$160,000
Machine 2:	60,000
Machine 3:	30,000
Machine 4:	10,000
Machine 5:	10,000
Total cost:	$270,000

The replacement costs for the same machines today would be twice this amount, or $540,000.

In 1952 the five machines were replaced by 1 transfer machine at a cost of $318,000. On the old machines, 3 men turned out 10 pieces/hr.; on the new machine, 2 men turn out 24 pieces/hr. As shown in Table 2, productivity increased from 3.3 to 12 pieces per man hour (or 3.6 times). The direct labor costs are calculated at a rate of $2.00 per man hour (prevailing rate for semi-skilled machine operator).

Table 2.—Costs for Machining Operations on Axle Housing.

	No. of Machines	*Replacement Cost*	*Productivity (pieces/man hr.)*	*Direct Labor (per piece)*
Original equipment	5	$540,000	3.3	61 cents
1952 *equipment*	1	318,000	12.0	17 cents

Case Study 3
Military Tank Suspension Support Housing

Operations performed: Rough and finish boring.

Source: The Cross Co.

These tank suspension support housings (Figs. 6-4 and 6-5) were made by two different manufacturers. Company A used standard boring equipment; Company B used a transfer machine.

COMPANY A

Equipment used: 3 standard boring mills (1 for rough boring, 2 for finish boring). The rough-boring mill ran on double shifts and turned out 3 pieces/hour; the 2 finish-boring mills ran on single shifts; each turned out 3 pieces/hour. (Note: night-shift laxity and lack of skilled labor were the reasons for running 2 finish boring mills on the day shift.)

Costs of these boring mills were $65,000 each.

One man was required to operate each machine.

COMPANY B

Equipment used: 1 transfer machine, which did both rough and finish boring. Only 1 man was required to operate this machine; he turned out 6 pieces per hour. The cost of this machine was $88,000.

COST COMPARISON

Note that it would require 4 standard boring mills (2 for rough and 2 for finish boring) to equal the 6-piece/hr.

Fig. 6-2. Axle housing discussed in case study 2.

rate of the transfer machine. These four machines would cost $260,000; and their productivity would be 1.5 pieces/man-hour. A comparison with Company B is given in Table 3. Direct labor is calculated at $2.00/hr.

Table 3.—Boring Costs on Tank Suspension

Company	*No. of Machines*	*Machine Costs*	*Productivity (pieces/m-h)*	*Direct Labor (per piece)*
A	4	$260,000	1.5	133 cents
B	1	88,000	6.0	33 cents

There were other advantages:

1. The operator could be trained in two or three days.
2. There was less downtime for repairs.
3. Since the tools were pre-set, there was no need for trial cuts and checking.
4. Tools and machines were heavier and sturdier.

A disadvantage was that tool grinding was more of a problem in Company B, since the transfer machine has more complicated tools than standard boring mills.

Case Study 4
Crankpin Grinding

This is an analysis of the economic problems involved in comparing two new installations; it is assumed that a decision to purchase new equipment has already been made.

Source: A speech on "Economic Problems of Replacement" made by Mr. Everett M. Hicks, Vice-President and Manager of the Grinding Machine Division of The Norton Company. (Presented at the 1953 Annual Meeting of the American Society of Mechanical Engineers.)

The so-called *MAPI formula* has been used in this study. MAPI is an abbreviation for *Machinery and Allied Products Institute*, which has sponsored research in the field of equipment practices and policies and has published "Dynamic Equipment Policy," an exhaustive treatment of this subject. The derivation and use of the MAPI formula is explained in the "MAPI Replacement Manual," a working handbook for those involved in equipment problems.

A brief description of the two proposed types of new equipment follows:

Machine "A" is the standard hand-loaded crankpin grinder which, in an oversimplified description, consists of a base on which is mounted a grinding wheel unit and a pair of offset synchronously-driven workholders to rotate the crankshaft around the pin to the ground. In the case of an 8-cylinder V-8 engine crank, there are four pins to be ground; the operator manually indexes the crank angularly after releasing the workholder clamps, and longitudinally by moving the machine table between the grinding operation on each pin. The operator must be in constant attendance during the complete operation and can, therefore, operate only one machine.

Machine "B" is a fully automatic transfer-type crankpin grinder which, for a V-8 crankshaft, is equipped with four grinding stations (one for each crankpin on the shaft).

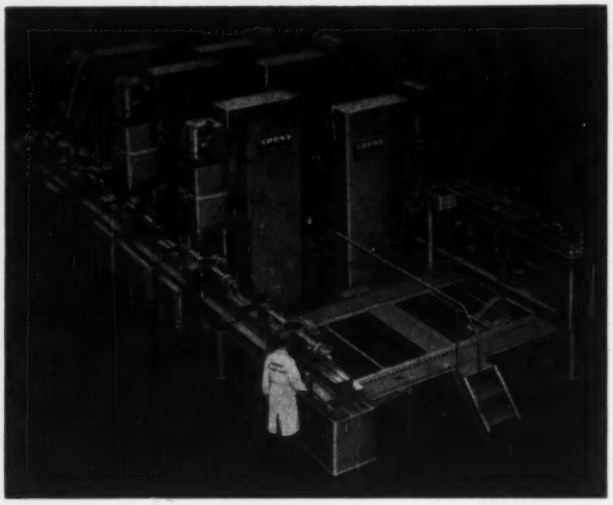


Fig. 6-3. Transfer machine for axle housing of case study 2.

There is automatic transfer equipment which moves the crankshafts progressively from one station to the next. As a pin is ground at each station, a finished crankshaft is completed with each cycling of the machine, the finished shafts being delivered back to the conveyor line from the last station. The shafts moving from one grinding station to the next are automatically indexed angularly and longitudinally. One operator is required to observe the functioning of the machine and to make any necessary adjustments.

Table 4 compares the operating advantage for one year of Machine "A" as compared with Machine "B." Note that savings have been shown wherever it is possible to determine a definite advantage for one machine or the other. The largest savings in this case, of course, is direct labor, because only one operator is necessary on the automatic machine as compared with five for the conventional machines. As the automobile plant that is considering this purchase normally operates on two shifts, the saving is a total of eight operators.

Note also that the Net Operating Advantage in favor of the automatic machine amounts to $57,604 per year, and

Table 4.—Operating Advantage Analysis of Two Crankpin Grinders

Income Advantages	*"A" Hand-Operated Crankpin Grinder*	*"B" Automatic Crankpin Grinder*
1. Superiority of product		x
2. Increased output	.....	.....
3. Other	.....	.....
Cost Advantages		
1. Direct labor (8 operators)		$42,000
2. Indirect labor (10%)		4,200
3. Fringe benefits cost (22%)	.....	10,164
4. Maintenance	.....	.....
5. Supplies	.....	.....
6. Tools	.....	.....
7. Spoilage	.....	.....
8. Down Time	.....	.....
9. Floor Space		27
10. Power (18 hp.—kwh/.013)	$ 697	
11. Property taxes and insurance (1% of capital cost difference)	790	
12. Other (grinding wheel saving)		2,700
	$ 1,487	$59,091
Net operating advantage	.....	$57,604

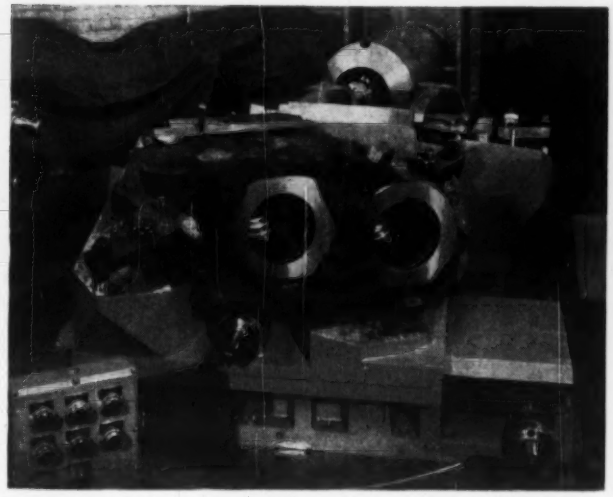


Fig. 6-4. Military tank suspension support housing discussed in case study 3.

this amount is transferred to Line 9 of Table 5. We also insert in Table 5 the Cost Installed of each type of machine, the estimated Service Life, and Salvage Value at the end of that life. The remainder of the calculation is made in accordance with the MAPI formula procedure. Note that what is quaintly called the "Adverse Minimum" is less for the automatic machine than for the hand-operated machines by $41,445. It should be understood that this gain is over and above the normal interest return on the capital investment, which is included in the calculation for each type of machine. The decision in this case is obviously in favor of the purchase of the automatic machine.

Table 5.—MAPI Formula Comparison of New Machine Installation

	"A" Hand-Operated Crankpin Grinders (5)	*"B" Automatic 4-Station Crankpin Grinder*
1. Cost Installed	$201,000	$280,000
2. Service Life	15 years	15 years
3. Estimated Salvage Value	1,105	1,040
4. Salvage Ratio	.55	.37
5. MAPI Formula %	10.1	10.2
6. Interest %	10.0	10.0
7. Total %	20.1	20.2
8. Adverse Minimum	$ 40,401	$ 56,560
9. Operating Inferiority	$ 57,604	.....
10. Total Adverse Minimum	$ 98,005	$ 56,560
11. Gain Next Year from Installation		$ 41,445

Case Study 5
Aircraft Fitting

Operations Performed: Machining of the part on the MIT milling machine.

Source: A speech on "Automatic Machine Control" made by Mr. Perry L. Nies of the Ultrasonic Corporation. (Presented on October 14, 1953; not quoted directly.)

It is expected that the aircraft industry will make a widespread adoption of computer-controlled equipment.

The Massachusetts Institute of Technology is now able to offer production experience on its well-known paper-tape-controlled milling machine. The MIT experience can be compared directly with current machining practices of the aircraft industry.

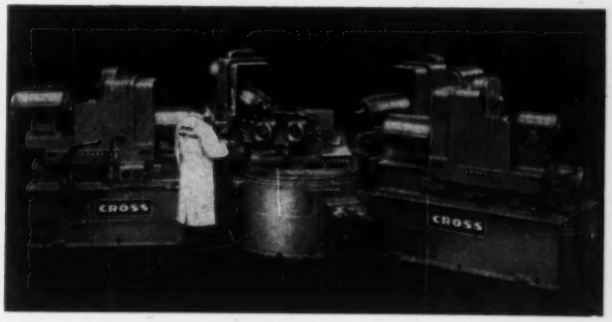


Fig. 6-5. Transfer machine for support housing of case study 3.

A case in point is a small aluminum fitting, used by a large air-frame manufacturer in a new plane. In deciding on the proper machining method, the manufacturing group was faced with these alternatives: (1) Kellering, (2) forging and finish machining, or (3) tape-controlled milling method.

In the past the choice had usually fallen to the forging-and-finish-machining method because Kellering suffers the disadvantage of excessively long machining time per piece.

The part was taken to the MIT Laboratory and completely milled from aluminum billets. Table 6 presents comparative cost data as made available by the airframe manufacturer and the MIT Laboratory.

Table 6.—Comparative Production Costs for Aircraft Fitting

(Size: 8" x 8" x 5"; No. Pieces: 33)

	Kellering Method	*Tape-Controlled Milling Method*	*Forging Die Method*
Make-Up Cost			
Model, die, and template Cost	$500.00		$10,000.00
Programming Cost (500 M-Hr.)		$1,500.00	
Machine Time			
Set-up per run		12 hours	
Machine time per piece, floor to floor	18 hours	6 hours	1½ hours
Hand-finishing, per piece	3 hours	3 hours	
Elapsed Time			
Blueprint to machine set-up	3 weeks	2 months	4-6 months

Case Study 6
Assembly of Radiator Pressure Caps

Operations performed: Putting together stampings, rivets, screws, gaskets, and springs; and inspecting the finished assembly.

Source: The manufacturer.

Investment in original automatic equipment: $34,000. Since this first unit included development expense, subsequent machines could be purchased at approximately $30,000.

Investment in non-automatic equipment: Tooling and equipment to produce this same assembly manually on non-automatic machinery would cost approximately the same.

Savings: The savings on this particular machine was for reduced labor only. This amounted to $3.32 *per thousand assemblies* as compared to the former non-automatic method of operation.

Total savings per year that were realized through the purchase and installation of this new machine was about $14,000.

Major problem involved: Acquiring uniform parts from the fabricating operations.

Case Study 7
Machining Engine Parts

Operations performed: Drilling, reaming, and cutting.

Source: "Push-Button Plant. It's Here!" *U. S. News & World Report,* December 4, 1953.

Crankshaft Drilling

It used to take 39 workers and 29 machines to drill a series of 18 holes in a crankshaft.

It now takes 9 workers and 3 machines to drill the same number of holes.

Rocker-arm Support

On a rocker-arm support, the necessary drilling, reaming and cutting used to be done by 5 workers and 2 machines to produce 38 pieces/man-hour.

Now, 1 worker and 1 machine turn out more than 750 pieces/man-hour. As shown in Table 8, the productivity gain per operator is almost 20 times. As fewer machines are needed, savings in floor space of up to 40 percent can be realized also. The direct labor cost is calculated in Table 7 at a rate of $2.00 per hour.

Table 7.—Productivity Gain for Rocker-arm Support Machining

	Workers	*Machines*	*Productivity (pieces/m-h)*	*Direct Labor (per piece)*
Then	5	2	38	5.3 cents
Now	1	1	750	0.3 cent

Case Study 8
Aluminum Cups

Operations performed: Turning of aluminum strips into finished cups.

Source: "Automatic Machines Carry Cost-Cut Talents To Little Factories Too." *The Wall Street Journal,* April 2, 1954.

The machine, made by the Hautau Engineering Company of Ferndale, Michigan, is an automatic machine that turns aluminum strips into finished cups at the rate of 2,000 per hour, or 16,000 cups per day.

1 part-time operator is needed to turn out the same production as it takes 55 men to do on standard equipment.

Net savings to the manufacturer: 4 cents a cup, or $640 per 8-hour day.

Cost of the new machine: $60,000.

Case Study 9
Rifle Grenades

Operations performed: Machining and assembling of grenades.

Source: "Automatic Machines Carry Cost-Cut Talents To Little Factories Too." *The Wall Street Journal,* April 2, 1954.

The installation is made in Moe Light Division of Thomas Industries, Inc., Fort Atkinson, Wis.

9 automatic machines machine and assemble the same work as 27 standard machines.

9 unskilled operators are needed against 27 skilled for the standard machines.

The automatic equipment cost $120,000 vs. $300,000 for the standard machines.

The new machines occupied only 1/3 of the floor space that was needed for the standard equipment.

Case Study 10
The Spectrometer

Operations performed: Direct-reading analysis on the spectrometer (sampling, analysis and reporting).

Source: Baird Associates, Inc.

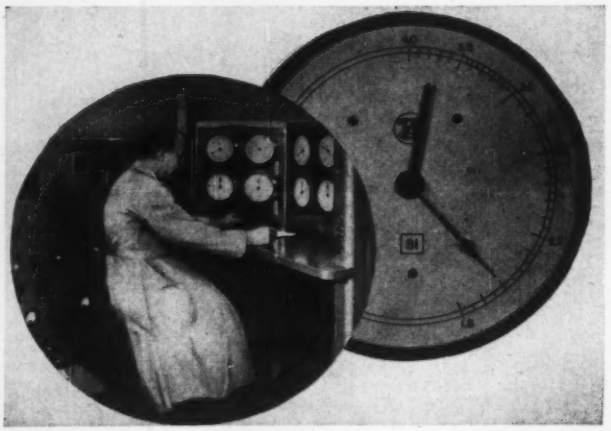


Fig. 6-6. Direct-reading spectrometer for rapid analysis, discussed in case study 10.

The direct-reading spectrometer (Fig. 6-6) is now used in many companies, one of them being the Ford Motor Company's Cleveland Foundry. It controls the quality by rapid quantitative analysis of certain elements in the molten metal from which castings such as blocks, cylinder heads, flywheels, and other parts are made.

Savings vary according to the load which the spectrometer carries. With one operator per shift there is a great saving in manpower. Cost of expensive chemical reagents is almost eliminated. In addition, the analyst works without strain and hazard.

The installation at Ford cost $35,000. It is estimated that this cost was absorbed in savings within less than one year's operation.

(Editor's note: Case study 10, on the direct-reading spectrometer, differs from the other studies in that the others compare various methods for performing the same operations. However, analysis of chemical composition by manual techniques is not comparable to the direct-reading-spectrometer technique because the latter provides a more rapid analysis, *enabling closer quality control.* This factor of superior results can outweigh the purely economic factors, as indeed it does in most instrumentation situations.)

Case Study 11
Project Tinkertoy

Operations performed: Manufacturing of electronic circuits.

Source: U. S. Navy Bureau of Aeronautics.

Table 8.—Comparison of Circuit Production Costs

Method	*Materials*	*Direct Labor*	*Mfg. O.H.*	*Totals*
Conventional	$35.85	$5.60	$5.44	$46.89
Tinkertoy Hand	20.56	5.99	2.27	28.82
Tinkertoy Machine	20.56	2.83	2.86	26.25

Investment required for the 400-module-per-hour hand process: $82,000.

Investment required for the 405-module-per-hour machine process: $665,000.

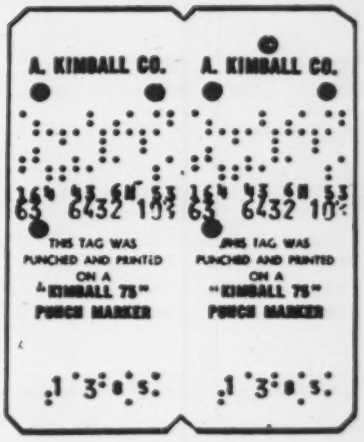
However, the difference in investment would be repaid from manufacturing cost *savings* within less than one year and five months of operation at full capacity.

An elaborate study of the manufacturing cost determination that lead to the figures above has been included as an appendix to this report.

(To be continued)

Fashion Merchandise Control

DEFORD C. MILLS and **ALBERT KUSHNER**
Cresap, McCormick and Paget


A. KIMBALL CO.
A. KIMBALL CO.
THIS TAG WAS PUNCHED AND PRINTED ON A "KIMBALL 75" PUNCH MARKER
THIS TAG WAS PUNCHED AND PRINTED ON A "KIMBALL 75" PUNCH MARKER

Punched price ticket

ALTHOUGH stores vary as to the number and kind of records and reports in use, satisfactory unit control of fashion merchandise can be achieved in a typical department store with four key records and reports:

1. A *continuous unit control record* (the basic record), usually by article number, which records item activity as it occurs—sale, return, transfer, etc. This basic record is the foundation of merchandise planning and control.
2. A *daily item flash report* which provides sales data by article number on all or selected styles experiencing sales on the *previous day.*
3. A *weekly price line report* which provides unit sales by price line for each classification of merchandise in a department for the *previous week.*
4. A *seasonal summary report* which most stores develop *by months,* of unit sales activity by price line within each merchandise classification of a fashion department. Sometimes inventory and on-order statistics are included, and usually last year's or planned figures.

Techniques Now Available

Three methods are available for maintaining the basic records and producing the daily, weekly and seasonal reports required to effect unit control of a fashion department—manual, punched-card machines, and electronic computers. What are the relative merits of each?

Manual production of the required data in a well-designed and managed system is generally successful in maintaining required time schedules, and requires little investment in equipment. However, this method incurs a high payroll cost which may be as much as 0.5 percent of sales or more, and an error incidence which may average 5 to 10 percent. In addition, peak loads tend to cause personnel problems and sharply increased costs.

Punched-card machines used with punched garment tickets represent a source of possible savings for larger stores employing five or more fashion-merchandise unit control clerks for report preparation, exclusive of the clerical staff required to maintain the basic records. Moreover, the machines tend to improve accuracy. Finally, these machines can handle peak loads more readily.

On the other hand, punched-card machines economically cannot maintain basic records, which must continue to be posted manually; they produce daily item flash reports more slowly; they cannot provide economically all data required on the weekly and seasonal reports.

Electronic computers capable of maintaining basic records and producing required reports for fashion merchandise unit control could be constructed. The major advantage is a marked increase in the speed with which data are made available, a matter of importance in merchandising, sales, and markdowns.

The probably high cost of a computer would rule out its use for fashion-merchandise unit control by all except larger stores employing approximately 13 or more clerks to maintain and prepare required records and reports. For such stores, however, substantial savings might be possible if the computer's capacity were sufficient to provide unit control for other categories of merchandise typically requiring a similar type of control.

Anticipated Equipment

This is the picture today. But certain equipment presently under development, but not yet commercially available, may be expected to contribute in the near future to the provision of fashion-merchandise unit control data:

(1) Interpreting punched card machine which will print a summary of the day's activity of an article number on the appropriate line of a card which could be a calender-type basic record. Fifty lines can be printed on a single card, thus providing entries for 50 days.

(2) Punched price tickets and a ticket reader.

(3) Price ticket to tape register.

(4) Electronic computers. A West Coast firm has announced a computer for merchandise unit control purposes with a capacity for 300,000 items.

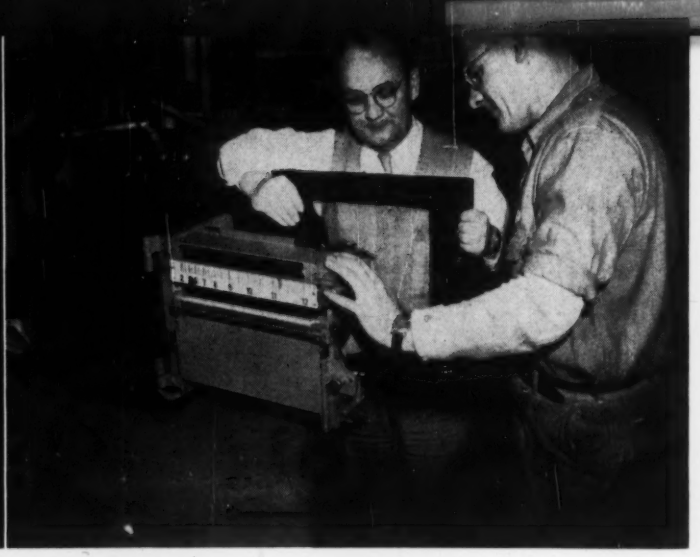
Course of Action for Management

There are four major actions which alert managements should take:

1. Have clearly in mind exactly what you require in the way of records and reports as to content, form, timing and frequency of preparation of issuance.
2. Factor out the costs of supplying these data by present methods, and evaluate existing procedures as to speed and accuracy.
3. Determine the costs, speed and accuracy of the use of punched-card machines or electronic computers for fashion-merchandise unit-control purposes in your store, and compare them with your existing methods. *Give full consideration to the possible use of the equipment for accounting or other merchandise control purposes.*
4. Select the most suitable method or methods.

*Abstracted from *The Department Store Economist,* 100 E. 42 St., New York 17, N. Y.

Harold Beacham, Foreman, (left) and Carl Sacco, Instrument Repairman, discuss an instrument problem. Optical pyrometers are basic tools in steel operations.



Foreman Beacham and Jack McAnany perform a routine examination of a recording pyrometer.

Steel-plant

Instrument Personnel Training

The Armco Steel Corporation, Butler Works, has diverse and difficult instrumentation problems. The Armco Training Supervisor reports on the organization and training activities, in which evening classes and instrument repair schools are featured.

GAIL ROSE
Armco Steel Corporation

BUTLER WORKS of Armco Steel Corporation is an organization of some 3500 people, operating six open-hearth furnaces and an electric furnace, plus rolling and processing equipment. We produce up to 30,000 tons of steel sheets and up to 12,000 railroad car wheels per month. In addition to open-hearth furnaces, soaking pits, slab-heating furnaces, open strip anneal and box annealing units, we have a variety of specialized equipment—(1) stainless strip annealing furnaces, (2) controlled-atmosphere strip annealing units for coated products, (3) three different types of controlled-atmosphere silicon annealing furnaces, and (4) slug-heating, reheating, and heat-treating furnaces for forged-steel railroad wheels.

Another complicating factor for our instrument personnel is that our original equipment was designed to use producer gas or natural gas. During the last ten years, however, our gas supply has not been reliable during the winter months. To alleviate this shortage a number of steps were taken:

(1) Fuel oil burning equipment was introduced in most of the heavier heating applications in the plant. (2) A plant was built to convert gasoline to gaseous fuel for use where the use of oil was impractical. (3) Propane was introduced as a fuel in some places. This choice of fuels and combinations of fuels complicates the lives of our instrument men during winter.

The instrument man's task is doubly important because we produce practically none of the so-called commodity grades of steel sheets. Our production consists almost entirely of "Zincgrip," "Aluminized steel," stainless, and oriented silicon steels, which require extremely close control of furnace temperatures, atmosphere, speed and gage.

Organization

How are we organized to handle these problems? We do not have our instrument servicemen collected into a single department. This is being studied at the present time, but has not yet been done. Our Metallurgical Department establishes and controls standard practices regarding all products in all operating departments. To help exercise that control the pyrometer servicemen in the Metallurgical Department service all temperature indicating and recording equipment throughout the plant, as well as gage, speed, and flatness-recording equipment on strip-rolling and processing units. Where heating is done electrically, they also service the control equipment involved. This group consists of 14 repairment under the direction of a Senior Pyrometer Serviceman. They make up their own thermocouples, and service over 400 different instruments in use on various units, in addition to portable equipment.

The Combustion Engineering Department is responsible for the servicing of all control equipment on installations using fuel other than electricity. There are 23 men in this department, including a Combustion Engineer and an assistant Combustion Engineer. In addition to handling fuel distribution and supply, they operate a stand-by gas-manufacturing plant and ammonia dissociators. They also keep in operation nearly 300 control instruments such as air-gas ratio, furnace-pressure, and flow controllers. We do not suggest that this particular organization and separation of functions is the best which can be achieved; but

Presented at Conference on Instrumentation for the Iron & Steel Industry, Pittsburgh, March 25, 1954.

it has grown up with us in Butler, and is working satisfactorily.

Training

Most training activity is done on the job by the senior repairmen and the supervisors of these service groups. The training never stops. If there are no new men to be enlightened, there is always new equipment being purchased and installed. When a new installation is made, the repair group is called together. They go over the manufacturer's instruction pamphlets, discuss the mechanics of the installation, and are informed regarding just what this piece of equipment is supposed to do.

At this time also, the *standard practices* that will be followed in servicing this new equipment are developed. These written standard practices are an extremely important part of on-the-job training. These were first written several years ago. We had an instrument repairman electrocuted while working on a 110-volt control circuit. One reason for having these standard practices is to prevent a recurrence of anything of that nature. Standard-practice booklets contain general safety instructions for application when working around particular pieces of equipment. They contain, in addition, information on the location of each instrument that is to be serviced, the number and type of thermocouples used, the recording chart to be used with that instrument, and the serial numbers of the instruments involved. Included also is a brief explanation of the functioning of each instrument and the role it plays in the functioning of the unit on which it is installed. Copies of these standard practices are provided for each of the servicemen. They are kept up to date and are in constant use. These standard-practice books, plus the manufacturers instructions prepared for specific pieces of equipment, constitute the basic training material of all our instrument repairmen.

Evening Classes

Most of our instrument servicemen have fortified themselves with additional training experiences. Some have taken correspondence courses, and all have been encouraged to participate in general educational programs conducted at the plant on an evening-class basis. The first of these is a course which we call "Mill Operations." In this class they learn about the operation of all departments of the Butler Works. The course consists of visits to different departments plus a discussion of each department with the superintendent involved. Printed information booklets are also provided covering operations and equipment in each department. This is followed by a "Metallurgy" class in which they learn more about the products we're making, and the metallurgical changes that take place as different grades of steel progress through the various operations. "Mathematics" is offered (arithmetic, algebra and a little geometry) for those who need a refresher before attempting to study with groups learning "Electricity"; 360 hours of classroom and laboratory training in electricity is offered covering a-c. and d-c. circuits, machinery, controls, circuit tracing, and trouble shooting. A number of these repairmen have also taken a familiarization course in "Electronics."

Foreman Beacham and Repairman Sacco analyze a pyrometer record.

Instrument Repair Schools

During the war years we sent a couple of men to instrument repair schools operated by manufacturers. They in turn trained our other repairmen. In time, however, they moved up in the organization and we had a shortage of experts in the repair group. A couple of years ago, we were discussing sending more men to manufacturers schools when someone suggested that we bring the school to Butler instead and give everyone special training. Arrangements were then made with the Brown Instruments Div., M-H, to conduct a special instrumentation course for all of our Pyrometer Servicemen and Combustion Engineering Department employees. This course covered a review of fundamental electricity, then went into thermocouples, millivolt meters, potentiometers, a little electronics and electronic instruments, pneumatic and electric controls, and trouble shooting. We held the class eight hours each week, scheduling half of each group in the morning and the other half in the afternoon of the same day. It was conducted for 12 weeks, making a total of 48 hours of instruction for each person. Mr. William Kirk was provided by Brown as instructor of the group, and he did a good job for us.

No text book was used for this course, but outlines and notes were mimeographed as the course progressed.

The thing that is really important is the "training climate" to which the individual is being exposed; the personal relationships that exist within the group; the way people feel about each other; the way they treat each other. If any effective training is to be accomplished, several favorable conditions must exist. Each individual must feel that he is accepted as a member of the group and is important to the success of the group as a whole. He must feel perfectly free to ask questions, to make suggestions and occasionally to make mistakes. He must know that his supervisor is sincerely interested in helping him to learn and to grow in the company. If you can develop this spirit of consideration and cooperation, you don't need to worry much about whether you have adopted the "right" program or are using the "best" training techniques.

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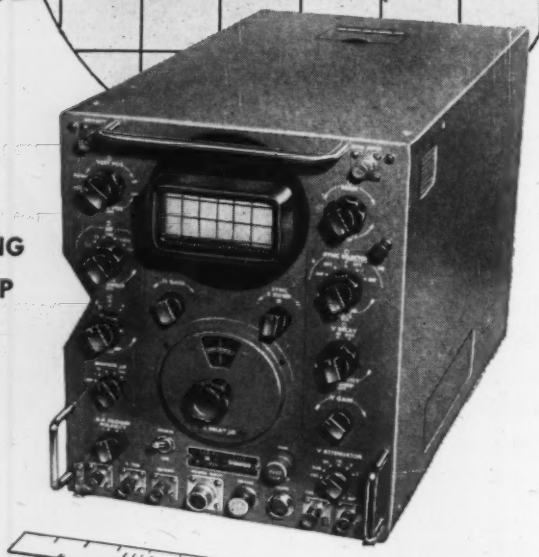
by Waterman



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Oil-field Instrumentation

The instrument man in the oil field is much on his own. Good measurement and control, vital to the field operation, depends on proper choice of equipment, proper tools and facilities, and proper attitude of personnel. This résumé covers the basic variables, measurements at the well, control of pumping and gas-lift wells, and selection of equipment. Shop and field maintenance facilities are described in detail.

MELROY WELCH
Sunray Oil Corporation

WILDCAT WELL is the potential discovery well for a new field. Measurement of its early formation tests is of vital interest to everyone interested in the well. Many important decisions will be based on the early measurements of rate and pressure, including the leasing of neighboring blocks of land and the drilling of other wells. Owing to the low ratio of discoveries relative to holes drilled it is rare that there will be any conventional separator, tanks, and metering set-up provided for the initial test. The testing and measurement man is pretty much on his own.

Measurement of the liquid production may be made by gaging in a drilling mud tank or in the sump.

Gas production rate may be determined by use of the Pitot tube. Fig. 1 shows an improvised pitot-tube set-up utilizing a section of 2-in. I.D. pipe and a Pitot tube fashioned from ⅛-in. iron pipe. The measurement is being made with a recording differential-type meter with one pot connected to the Pitot-tube and the other vented to atmosphere. A "U"-tube manometer is used to check the meter. The recorder also may have a Bourdon-tube pressure element in it which, having a 100-psi. pressure range, can be used instead of the differential element if the flow should prove too great for the differential range.

Formulae and tables for convenient use of the Pitot tube may be found in Monograph 7, "Back Pressure Data on Natural Gas Wells and Their Application to Production Practices," published by U. S. Department of the Interior, Bureau of Mines.

February Meeting: *Thursday, the 26th, Rio Hondo Country Club, Downey, Calif.*

Feature: *Annual Hi Jinks starting at 6:30 A. M.*

Should the gas be accompanied by slugs of oil or water so that the Pitot tube tends to plug off, it is suggested that the 4-diameter side static method be used (Fig. 2).

Tables for interpreting readings from the side static method, and details as to dimensions, also are in Monograph 7.

An improvised method for running a Pitot-tube test in the field when no manometer or pressure gage of proper range is available is as follows: Obtain a length of small-diameter tubing having an I.D. of from ⅛ to ⅜ inch.

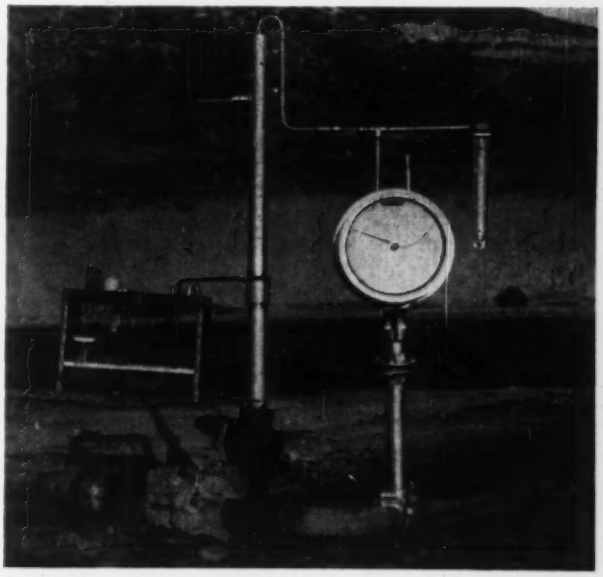

Fig. 1. Pitot-tube and meter setup for measuring gas production rate from a wildcat well.

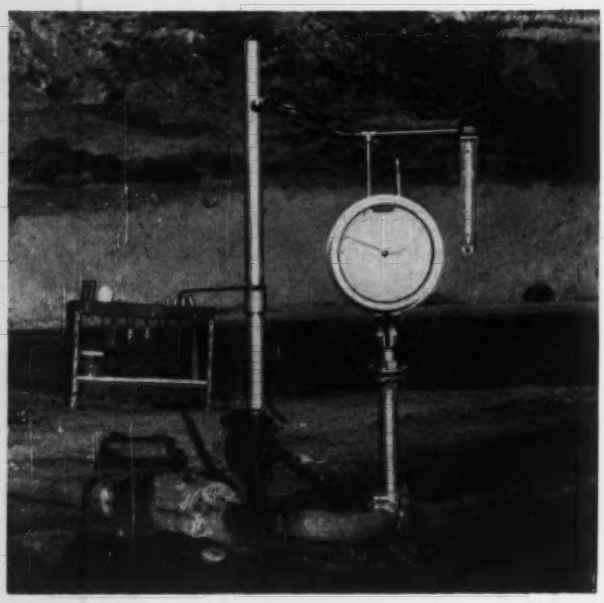

Fig. 2. Side static method recommended when oil or water plugs up the Pitot tube.

Bend one end into a curve similar to that shown in Fig. 1. Tubing might be obtained from the gas or gasoline fuel line to an engine. Holding the tip of the tubing over the discharge end of the torch line, even with its face and in the exact center, immerse the free end of tubing in a container of water. Immerse the end until the bubbles of gas just cease to escape, then mark the depth of immersion. The depth of immersion will indicate the inches of water pressure impact on the Pitot tube. The formula for a Pitot tube is $Q = 34.69d^2\sqrt{W}$. Therefore, multiply 34.69 times the diameter of pipe (in inches squared) times the square root of the water reading (in inches) at center impact. The result will be rate of flow in thousands of cubic feet per 24 hours at 14.73 psi., 60 deg. F., and specific gravity of 0.600.

Production Measurement and Control

Measurement of quantity and composition of crude oil, natural gas, salt water, and sediment produced from a well is essential to provide proper information to reservoir engineers, accountants, production engineering and management groups.

Measurement of pressure and temperature in the reservoir before and after production of certain volumes of substances make possible the calculation of the effective size of the reservoir and the prediction of its future behavior.

Control of rate, pressure, and temperature is essential to all phases of the production problem, through the entire producing cycle from the time that fluids enter the well bore until they are properly segregated and delivered to refinery, absorption plant, water disposal system, and sump.

The number of control devices used in modern deep producing fields is much greater than those used in simple shallow fields a generation ago. One typical field, having approximately 120 wells producing at depths from 7,500 to 14,500 feet, uses about 2,250 flow, temperature, pressure, rate, or measurement devices—an average of almost 20 instruments per well.

Accuracy of Measurement and Control

Management requires accurate work from all groups in a producing organization. Master metering helps average out the effect of heads in systems with widely fluctuating readings. Recorded information is used by many people in an operating organization. Production engineers base their planning of production rate and the sizing of equipment upon it. Reservoir engineers calculate the effective size of the reservoir and its behavior upon field measurements. Accounting people require accurate measurement to base their distribution of costs and income.

Volume, temperature, pressure, and composition are interdependent upon the good control of each. All separation of products in production is a function of vapor pressure and phase behavior; therefore, composition varies with variation in control of pressure or temperature. Importance of good temperature control applies particularly to crude-oil-heater and wash-tank temperatures to prevent loss of vapors and reduction of crude-oil price because of gravity reduction.

Positive control of well production rate is necessary to prevent waste and possible damage to wells and the reservoir.

Good pressure control is essential to safe operation of lines, vessels, and other equipment. As all vessels and lines are protected from over pressure by use of relief valves, proper flow or pressure control will prevent losses through the relief systems.

Control of Production from Reservoir to Plant

Well gas flows from its reservoir of oil sand into the well bore as the result of pressure differential when pressure within the bore is lowered.

In a natural flowing well, pressure differential is created by opening tubing through a production bean valve* into a flow system of lower pressure. Flow bean valves are graduated into equivalent orifice sizes by 1/64-inch increments. The more common one is a large needle valve with calibrated stem and locking system to maintain its position as set. Other bean valves utilize interchangeable fixed orifice plugs. Some types have a carrier which may be loaded with a variety of orifices which facilitate quick change or renewal.

Flow beans are used to take high pressure drops in flow control, and are manually set to regulate flowing well rates. At pressure reductions of 2 to 1 or greater, the well rate is not affected by downstream pressure fluctuations due to the physical law of critical flow. A fixed bean can be placed in the bottom of the well (if the well is of very high pressure) to take the initial pressure drop and to reduce likelihood of freezing. Such a bottom-hole choke also serves to protect a high-pressure well by limiting its production in event of accident to the surface equipment.

Measurements at Well

Measurements ordinarily made at the well location consist of pressure readings (either indicating or recording) on the casing, tubing, and flow line. Initial readings at time of well completion and periodic check readings should be made with a dead-weight tester or with test gages checked before and after taking well readings. Gages used for such careful readings should be protected from the sun and checked at approximately the same temperature as when they were used.

*A flow bean is a manually operated valve with accurately calibrated indication of stem position vs. inner orifice, or with facilities for rapidly changing inner orifices to effect flow control.—Ed.

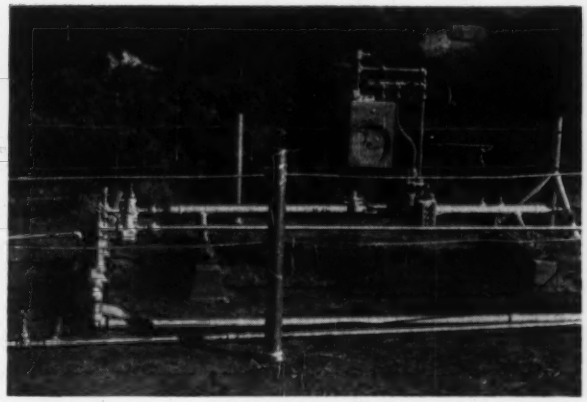

Fig. 3. Field orifice-metering installation for wet natural gas.

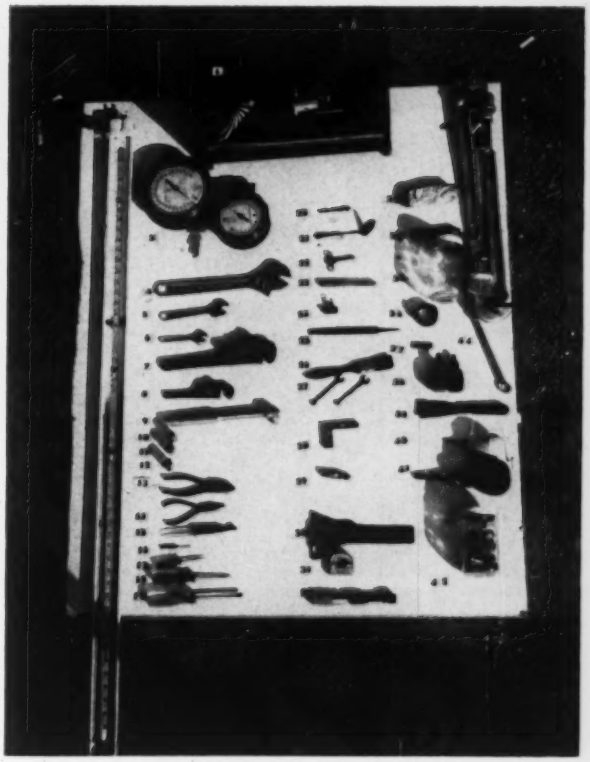

Fig. 4. Minimum tools for field service.

Bottom hole pressure of wells is of considerable engineering significance. In flowing wells it is obtained under both static shut-in condition and under flowing conditions. The pressure difference, compared to a given rate of production, is used to determine a well's production index, or P.I. The pressure observation is obtained by lowering a special bomb-type recorder through a lubricator on the head of the well by means of a wire line and depth-measuring device. Temperature and pressure readings are taken from within the well tubing throughout its depth by this means.

If bottom hole pressure of a well is insufficient to give desired production rate, an artificial lift is used. Most popular methods are the bottom hole pump and the gas-lift.

Control of Pumping Wells

Control of production rate of pumping wells is obtained by varying pump stroke rate, stroke length, pump diameter, and degree of submergence. Pump performance and equipment torque load is measured by a dynamometer, which is a type of recording strain gage which plots the variation in foot pounds of the applied load throughout the pump cycle. The chart may be used to analyze rod load, degree of counter balance, operation of pump valves, and other details of pumping-well performance.

Fluid level in the annulus between casing and tubing is of considerable significance in analyzing well or pump performance. Fluid level is measured by sonic means and recorded by an electronic recorder.

Control of Gas-Lift Wells

Production from gas-lift wells is controlled by regulating rate of gas-lift gas either through a manual bean or pressure-pilot-controlled regulator, or on a time cycle basis. Gas volume measurement is necessary on the gas going into the well and on all gas coming from the well. The wide fluctuation in flow on intermittent gas-lift cycles introduces serious difficulties in recording and reading of orifice-meter charts. Frequent over-ranging (resulting in contamination and loss of mercury in mercury-type flowmeters) has provided a fertile field for the manufacturer of dry bellows-type differential gages built with adequate over-range protection.

Master metering of groups of wells in a producing system as a means of prorating differences in individual highly variable flow rates has helped to raise the over-all measurement accuracy. The reservoir effect of a group of lines, and the averaging out of staggered heads from a series of intermitters, give an improved chart and consequent greater accuracy in field measurement.

Separator

Total well production (gas, oil, and water) flows from the well, through a flow line, to an oil and gas separator. The separator is a pressure vessel of sufficient capacity to provide time for gravity separation to occur between the wet natural gas and the liquid oil and water. The pressure and temperature at which the trap operates governs the composition of liquid (leaving the separator) and gas (going to the gas-gathering line). The gas passes overhead from the separator, thence through an orifice flowmeter recorder, and into the gas-gathering system. A liquid-level controller governs a valve in the liquid line leaving the trap and maintains a liquid seal within the trap. If the crude oil is clean it may be measured with a displacement or weight-type meter as it leaves the separator. In other installations the oil may be tape gaged in a gage tank. Should the crude contain much water emulsion it may pass through a thermostatically controlled heater and thence to a wash tank where the water is separated out and measured. Water is usually measured by displacement meters; for a group measurement on large volumes the brass-faced "V"-notched wier equipped with a sensitive level-indicating recorder can be used also.

Selection of Equipment

Proper selection of equipment can be made only following accurate analysis of service to be performed by the equipment.

Unfailing source of actuating energy is essential to proper operation of controllers. Convenience of nearest electric supply and the past outage record are important

Fig. 5. Instrument shop for calibration and overhaul.

Fig. 6. Paint and storage room.

considerations, as is availability of compressed air for pneumatic operation. Investigate also the cleanliness of natural gas and the likelihood of hydrate formation.

Availability of spare parts and skilled service for the equipment being considered is very important. Check with other operators in your area having similar control and measurement problems; one can gain much from the experience of others.

In making final selection strive for ruggedness and simplicity so that a large number of operating people may understand the use and maintenance of the equipment.

Considerations Peculiar to Wet-gas Measurement

Wet natural gas is subject to hydrate formation, freezing, condensation, and erratic changes in flow rate. Some elements of installation arrangement in field orifice metering are shown in Fig. 3.

The meter run illustrated is a semi-portable one designed to be moved readily by field crews. It has simple supports equipped with leveling screws. The orifice fitting is mounted on its side to permit tap lines to be vertical for good drainage of condensate. Tap lines are of large diameter (½-in. pipe) for good drainage and mechanical strength. The meter is mounted low and near the orifice fitting to keep lines warm to prevent hydrate formation. Thermometer wells, gage connections, and sample connections provide ease in testing and checking meter. A metal tag welded to the meter run gives internal tube dimensions. The meter has 100-in. differential range to take care of wide fluctuations in rate. Its clock has an easily changed arbor to convert to a short-period chart for making analyses of widely fluctuating flows. The meter and run is numbered so that good maintenance records can be kept.

Service and Repair

Performance of measurement and control equipment is directly related to the quality of the maintenance and repair program under which it operates.

Close coordination with manufacturers' representatives is a strong factor in obtaining the best performance inherent in the equipment. Most manufacturers are eager to help a customer in his personnel training program, and will aid in setting up your service department.

Attitude is an important factor in service personnel. One device which may be used to encourage proper attitude is to ask service people to explain and demonstrate the function and workings of the equipment to the operating group. This may often be arranged through the safety meeting.

Proper and adequate tools are essential to a good service program. The following tool list is considered a minimum for the performance of field type of day-to-day maintenance (Fig. 4):

1. Small tool box (open-rack-type).
2. Manometer, connecting hose, and aspirator bulb.
3. Test gage.
4. 12-in. adjustable wrench.
5. 6-in. adjustable wrench.
6. 4-in. adjustable wrench.
7. 10-in. pipe wrench.
8. 6-in. pipe wrench.
9. 8-in. flex handle, ½-in. drive.
10. 7/16-in. 12-point socket.
11. 9/16-in. 12-point socket.
12. ⅝-in. 12-point socket.
13. 6-in. side-cutting lineman's pliers.
14. 5-in. long-nose pliers.
15. 5-in. instrument tweezers.
16. 1½-in. over-all by 1/16-in.-bit screwdriver.
17. 4-in. over-all by ⅛-in.-bit screwdriver.
18. 7-in. over-all by 3/16-in-bit screwdriver.
19. 12-in. over-all by ⅜-in.-bit screwdriver.
20. 3-in. pin vise with length of #60-gauge spring wire.
21. Stainless-steel teaspoon (for mercury).
22. Clock key.
23. Pocket-size oiler with instrument oil.
24. Paper clip for holding chart.
25. 8-in. flat file.
26. ½-in. paint brush.
27. Small calibrating wrenches.
28. Small cross level (hor. and plumb).
29. ¼-in. standard pipe tap.
30. Inside vernier caliper rule.
31. Steel pocket rule.
32. Lubricator with grease.
33. Tube of distributor grease.
34. Tube of pipe dope.
35. Cleaning solvent or acetone.
36. Friction or plastic tape.
37. Fine arkansas slip stone.
38. Pair of ink bottles.
39. Putty knife and scraper.
40. Ear syringe for washing pens.
41. Battery syringe for cleaning instruments.
42. Miscellaneous spare parts.
43. Two 18-in. light-metal pipe wrenches.
44. Combination box-end wrench, 9/16-in. and ⅝-in.

This group of tools will prove invaluable in the shop as well as in the field; such a kit will easily pay for itself in time saved preventing return trips to the shop when minor repairs are required in the plant or field.

Instrument Shop

Any field having many instruments will soon pay out a moderate instrument shop in which to calibrate and overhaul instruments. A typical shop of this nature is illustrated in Fig. 5.

Note the glass jars containing spare parts for instruments. Each jar contains a tag listing instrument name, part number, approximate cost, number desired in stock, and source of supply. Boxes in lower shelving contain larger items such as clocks, and have tags tacked to them with information similar to the tags on the glass jars.

A portable instrument stand with leveling screws and wrench shelf is shown in center of photo. The tool box with the minimum tool list described is shown on bench to the left.

A dead-weight tester is shown in center right. It is used to calibrate pressure gages, both recording and indicating. A calibration sheet is made out on each gage tested and kept on file.

A manometer column filled with mercury and with scale calibrated in psi. is shown to right of bench. It is used to calibrate vapor-pressure gages.

A 100-inch manometer using water is shown next to door. It is used to calibrate flowmeters. The adjoining room is a paint and storage room, and is illustrated in Fig. 6.

Paint and Storage Room

The spray booth in the corner was field fabricated from 16-gauge black iron and has a 20-in. exhaust duct leading through the roof. A discarded truck fan in the duct is driven by a 1/3-hp. electric motor. Interior panels of black metal, coated with soap emulsion for easy cleaning, are readily removed. A screen rack packed with steel wool provides filter for absorbing wet paint and protects outside parking area from flying paint particles. The circular table within the booth has a revolving bearing and enables operator to turn work while painting. The table has casters; it may be rolled out and the portable meter-stand substituted if desired.

The metal shelving to the right is the paint drying rack. Small boards with metal screen and nail points to hold small parts provide easy handling while painting successive coats.

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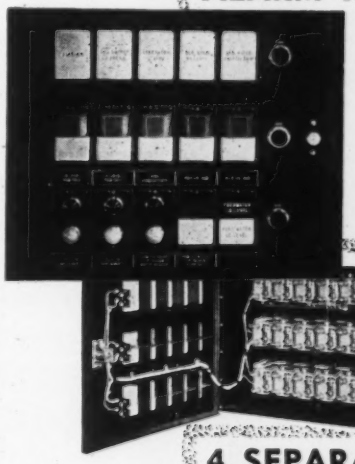

are shown in this typical installation. Includes back-lighted nameplates, turret lenses and bullseyes, all grouped for quick indentification.

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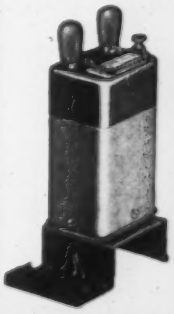

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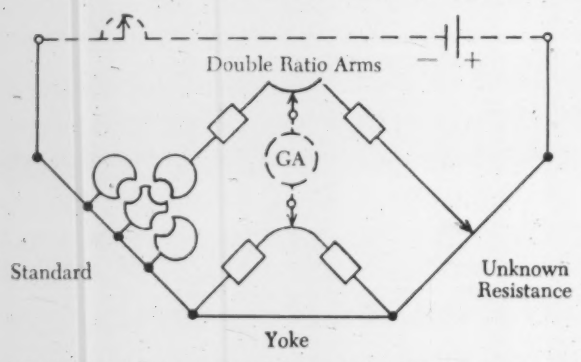
The bridge itself is essentially a Kelvin bridge modified to permit reading per cent conductivity directly (see simplified circuit diagram). With the standard and sample connected in the appropriate arms, a sliding contact on the sample (not shown) is adjusted until the bridge is balanced. The operation simply consists in finding the length of the sample wire that has the same resistance as that of the standard wire; and since the conductivity of the standard is known, the scale is calibrated to show the conductivity of the sample in terms of that of the standard. (*From new* 24-*page Data Sheet Group E*-53, "*Bridges and Ratio Sets for D-C Resistance and Conductance Measurements*", *Leeds & Northrup Co.*, 4934 *Stenton Ave., Phila.* 44, *Pa.*)



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Quartz Crystals

For more than 30 years General Electric has been designing, engineering and manufacturing quality quartz crystals. The (following) frequency availability chart gives frequency range (from 5 kc. to 100 Mc.) with holder-type details. (*From new* 6-*page Brochure ECQ*-1, *General Electric Co., Germanium Products*, 3800 *N. Milwaukee Ave., Chicago, Ill.*)

For this literature circle **402** on inquiry card.

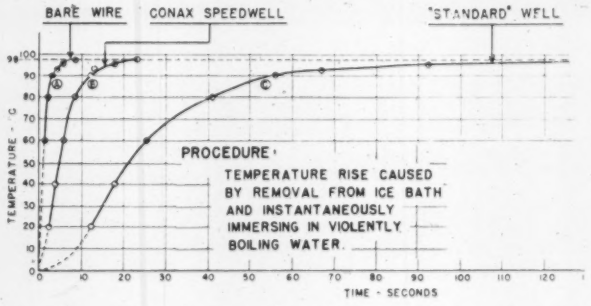
Transistor Power Supplies

There are really two basic questions relative to transistor power-sources. The first question concerns the present-day power requirements of transistors, and the second is in regard to the future power requirements which industry can expect. The fact that transistor characteristics are, in a sense, ideal implies generally that in Class A and Class B operation the theoretical limit of 50% in power efficiency may be virtually realized in practice, and perhaps 100% efficiency can be approached in Class C amplification. Hence, for all practical purposes, in any power application these rule-of-thumb efficiency figures can be used to calculate the magnitude of the power required from the primary-power source. Further, because of the ideal shape of the characteristics, the rule may be applied in any power range from the micro-power levels of present-day transistors to the probable large power-level operation of power transistors to be produced in the future. (*From new* 12-*page Form* 1-7, "*Power Requirements for Transistor Circuits*," *by Mr. J. Dalfonso, P. R. Mallory & Co., Inc., N. Tarrytown, N. Y.*)

For this literature circle **403** on inquiry card.

Thermocouple Response

The low mass of bare wire thermocouples gives almost instantaneous response to temperature change as graphically illustrated below. However, when corrosion or erosion necessitates a protection tube, the Conax Speedwell can sense temperature change with only 7 times the lag of a bare thermocouple. Lag in the "standard" well is approximately 50 times greater than the bare wire thermocouple. These comparisons are accurately illustrated in the chart. (*From new* 16-*page Catalog* 1530, *Conax Corp.*, 4515 *Main St., Buffalo* 21, *N. Y.*)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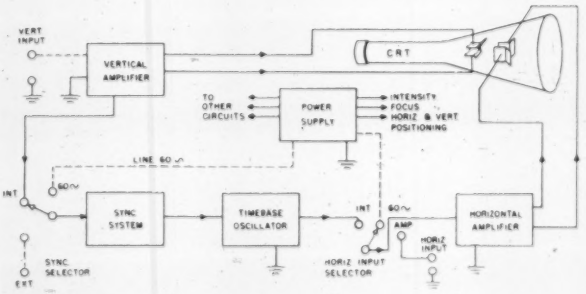
Oscilloscope Principles

As a general rule, all oscilloscopes will follow a basic method of construction although a few variations may be experienced. An oscilloscope must have the following components: (1) A vertical amplifier. (2) A horizontal amplifier. (3) Synchronizing circuits. (4) Sweep circuits. (5) The cathode ray tube and its associated circuits. (6) A power supply; both high and low voltage.

There will be a brief description of these sections later on, but first it is well to see basically how these various components are arranged in a typical oscilloscope. The block diagram illustrated is an arrangement common to most scopes. Particular attention should be given to the Sync. Selector and Horiz. input selector switches. These



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NETHERLANDS:	Gemeente-Electriciteitsbedrijf, Dordrecht
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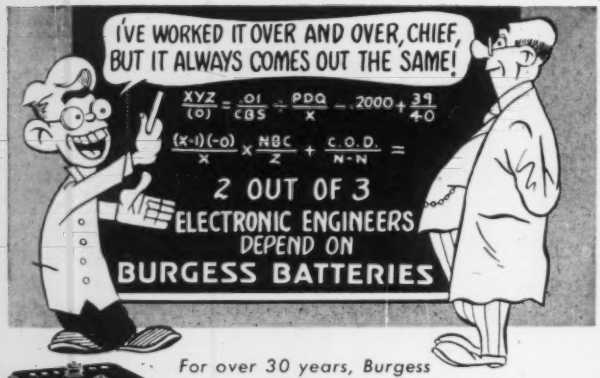
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play an important part in the proper use of a scope. (*From new 24-page Scope Catalog* 25410 *C, The Hickok Electrical Instrument Co.,* 10514 *Dupont Ave., Cleveland* 8, *Ohio.*)

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Ultrasonic Testing

The Reflectoscope produces pulses of ultrasonic sound waves which are beamed into the material normal to the test surface, or at a convenient angle, by the application of a piezoelectric search unit. The search unit converts electrical oscillations into mechanical vibrations and vice versa. These sound waves travel through the material under test and when they encounter any discontinuity in

the test piece, or the opposite side, they are reflected back to the search unit. The converted sound waves are portrayed as a definite pattern on a cathode ray tube. A system of distance markers is used for accurately locating the discontinuities. . . . Pictured is a typical test pattern that appears on the Reflectoscope screen. (*From new* 8-*page Bulletin* 50-105, *Sperry Products, Inc., Danbury, Conn.*)

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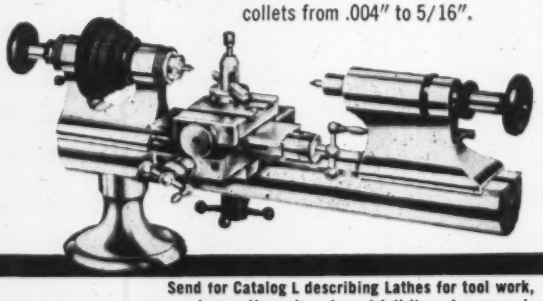

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Linear Differential Transformers

Most basic methods of measuring weight, force, pressure and acceleration depend on a comparison of distortion in an elastic member against a scale. The measurement of force or weight is accomplished by means of a resilient member and a device for measuring the position of a point on this member relative to a fixed reference.

The Linear Variable Differential Transformer is a device from which an electrical output may be obtained to indicate the position of its core. As shown in Figure, three coaxial coils are spaced along an insulating coil form which has a hole parallel to its axis. A magnetic core, when positioned in this hole provides a preferred path for magnetic flux linking the coils. . . . This arrangement can be designed so that movement of the core produces a change in mutual inductance that is linear with displacement. This is the principle of the Linear Variable Differential Transformer which will be described.

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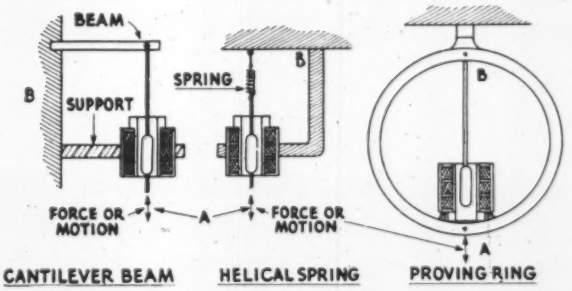

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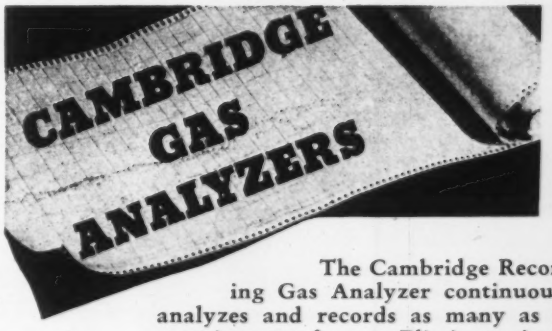

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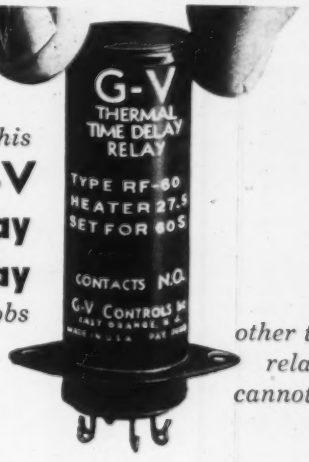

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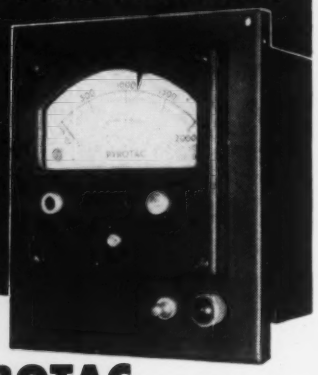

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BRIEFS—CONTINUED

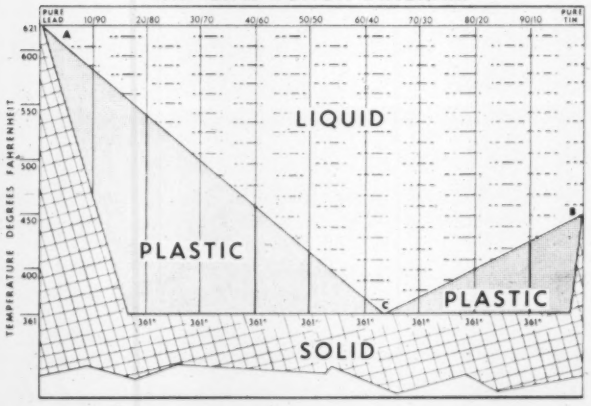
is in the order of 0.5% of scale. The resolution is usually in the order of 0.1% of linear range. The minimum balance point is usually less than 1% of range. (*From new 10-page Bulletin AA-1, Schaevitz Engineering, P. O. Box 505, Camden 1, N. J.*)

For this literature circle **407** on inquiry card.

Solder Fundamentals and Use

Literature on the subject of Solders and Soldering Fluxes, particularly the latter, is singularly meager and inadequate, and generally unrelated to practical and industrial realities. . . . It is the purpose of this Book to rectify some of these existing inadequacies, and to provide, for the solder user, a sound factual background underlying the basic fundamentals of Solder and Flux technology

TIN-LEAD FUSION DIAGRAM



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as it applies to the realities of industrial application and usage.

Ordinary soft solder is a fusible alloy, consisting essentially of tin and lead, and used for the purpose of joining together two or more metals at temperatures below their melting points. In addition to tin and lead, soft solders occasionally contain varying amounts of antimony, bismuth, cadmium or silver which are added for the purpose of varying the physical properties of the alloy. However, in many solders, some of these elements, notably antimony, are only present as impurities.

The overall quality of a solder is governed by several factors, such as speed of alloy formation, flow and spread of solder, chemical stability of the soldered connection, soundness and porosity of the joint, and physical resistance to shock, strain and stress.

There is no satisfactory tin substitute—when faced with the necessity of reducing the tin content of solder: Improve the technique of the soldering, procure better and cleaner metals to solder, adjust the temperature of flame or soldering iron, and specify a more concentrated flux, but do not attempt to substitute some metal for the lost tin. (*From new 84-page book "Solder—its fundamentals and usage," Kester Solder Co., 4201 Wrightwood Ave., Chicago 39, Ill.*)

For this literature circle **408** on inquiry card.

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The "Megger" ohmmeter is a permanent-magnet, moving-coil indicating instrument whose accuracy is independent of the exact voltage supplied for the test. No compensation or adjustment for voltage is necessary.

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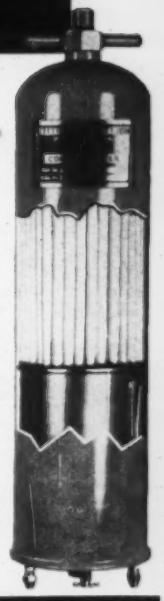

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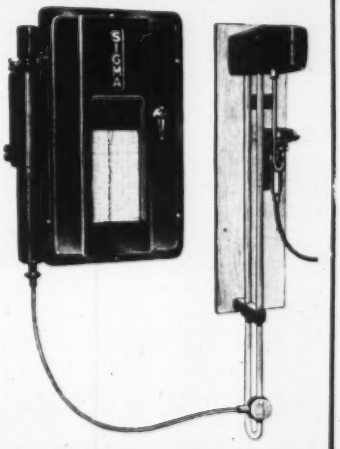

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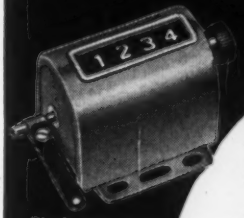

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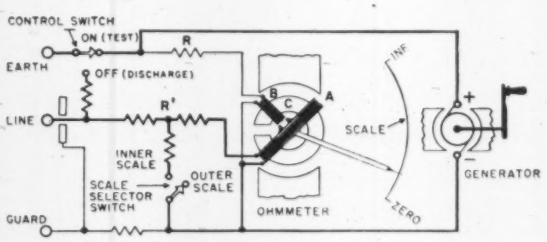

spring-supported jewel bearings.

A C-shaped iron core is mounted in a fixed position coaxially with the moving system and forms an important part of the ohmmeter magnetic circuit.

There are no control springs such as are used in ammeters and voltmeters. Current is led to the coils by lead-in spirals which are flexible and conducting and offer only slight restraint, so that when the instrument is level and no current is supplied, the pointer should float in either direction over the scale.

Coils *A* and *B* are so connected that when current is supplied they develop opposing torques and tend to turn the moving system in opposite directions. The pointer takes a position over the scale where the two torques are balanced.

With either perfect insulation or nothing at all connected to the testing terminals, no current will flow in the deflecting coil *A*. The control coil *B*, however, receives current and will take a position opposite the gap in the C-shaped iron core, Fig. 10. The corresponding position of the pointer over the scale is marked Infinity.

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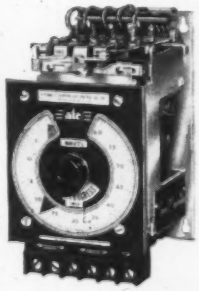

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RESET TIMERS

For more information circle **113** on inquiry card.

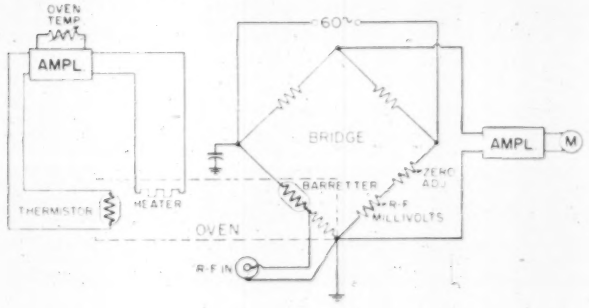
from the Infinity position into a field of gradually increasing magnetic strength until a balance is obtained between the forces exerted by the two coils. In this manner the control coil *B* acts like a restraining spring. (*From new 24-page Bulletin* 21-20, *James G. Biddle Co.*, 1316 *Arch St., Phila. 7, Pa.*)

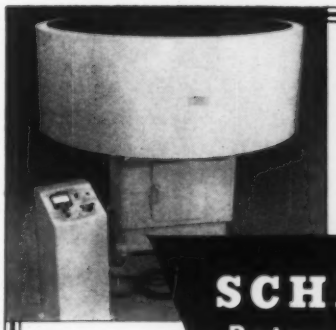
For this literature circle **409** on inquiry card.

Barretter

The Model 202-B High Frequency Barretter is a portable instrument for the precise measurement of radio-frequency voltages. This new model with greatly increased stability and improved VSWR provides the most accurate standardization of high-frequency voltage available at the present time.

[Editor's note: Bolometers are resistance elements that are highly sensitive to temperature. There are two types—*barretters* (normal resistors with positive temp. coeff. of resistance) and *thermistors* (metallic oxides with negative temp. coeff. of resistance).]





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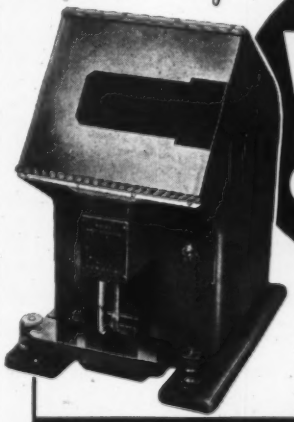

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The Model 202-B consists of a bolometer bridge which is unbalanced when the measured radio-frequency current changes the resistance of a temperature-sensitive barretter. The magnitude of the applied radio-frequency voltage is indicated on the dial of a calibrated resistor which is adjusted to restore the bridge balance. To insure high accuracy and stability, the barretter is mounted in a temperature-controlled oven. (*From new 64-page "Laboratory Standards," Measurements Corp., Boonton, N. J.*)

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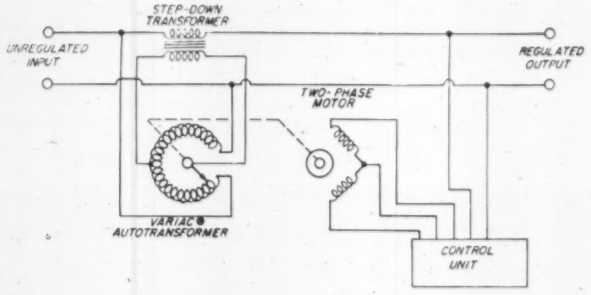
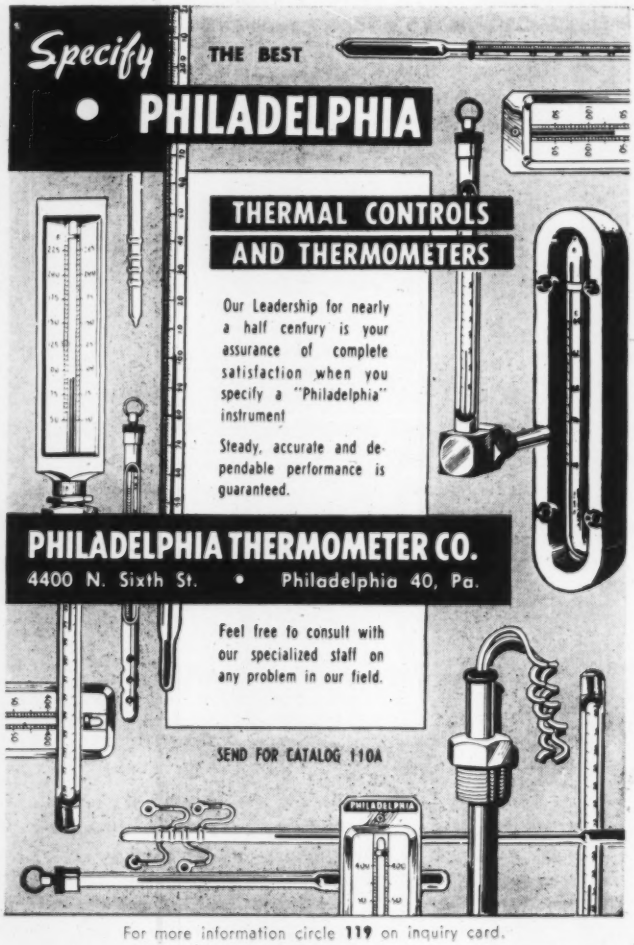
Line-voltage Regulator

The "buck-or-boost" circuit used as the means of control is shown at the left in the functional diagram. This permits the control of high-power circuits with a low-power



Variac, thus effectively multiplying the Variac rating. . . . A two-phase servomotor operated by a control circuit positions the Variac so that the output voltage is held constant. (*From 8-page July, 1954 issue of "Experimenter," General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.*)

For this literature circle **411** on inquiry card.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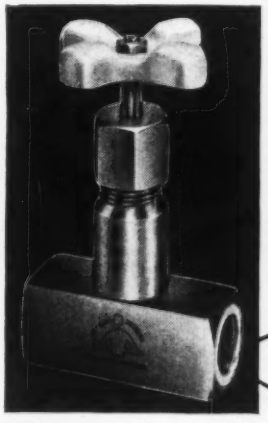
GLOSSARY

J	Jump Angle	Q_{ci}	Indicated Impact Pressure
K	Ratio of specific heat at constant pressure to specific heat at constant volume.	R	Range
		T_1	True Ambient Temperature
M	Mach Number	T_{ind}	Indicated Ambient Temperature
N_l	Linear Acceleration	T_L	Rocket Launcher
N	Acceleration (normal to flight path)	TAS	True Airspeed
N_t	Torsional Acceleration	W	Aircraft Weight
P_s	True Static Pressure	WS	Wing Loading
P_{si}	Indicated Static Pressure	α	Angle of Attack
P_T	Total Pressure	β	Angle of Yaw
Q_c	True Impact Pressure	ρ	Density

of these input parameters in the form required by the principal computers and control systems of the aircraft. This latter operation includes the computation of quantities which, though they might be considered basic, cannot be measured directly; for example, true airspeed.

Other quantities, such as slope of the lift curve, the relationship between indicated ambient air temperature and true temperature, or the factors which relate local angle of attack as measured by a vane to true angle of attack, can also generally be determined by calibration as functions of Mach number and/or other quantities determined by the computer. (*From new 8-page Brochure ADC-1, Servomechanisms, Inc., Post & Stewart Aves., Westbury, N. Y.*)

For this literature circle **412** on inquiry card.



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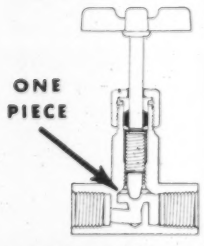

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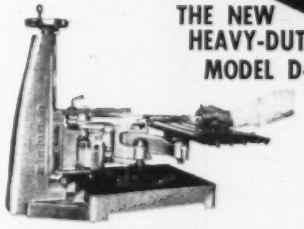

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Test Your I. Q. (Instrument

Question 1

The Massometer measures the mass rate of flow of free-flowing solids. One of the following statements about the Massometer is NOT true. This erroneous statement is:

(a) The Massometer is essentially a centrifugal pump.
(b) The solid material is weighed on a belt.
(c) The impeller is driven by a constant-speed motor.
(d) Motor torque is converted to 3-15 psi.

Question 2

The Merchen scale feeder controls the flow of solid materials. One of the following statements about this feeder is NOT true. The erroneous statement is:

(a) The feeder uses the weigh-belt principle.
(b) The weight signal is detected by a force-balance mechanism.
(c) Mercury switches control a motorized gate.
(d) Flow is controlled by weigh-belt-motor speed.

Question 3

Industrial plating operations, such as at the Oneida Ltd. plant, have wastes consisting of

(a) acid waste
(b) alkali waste
(c) silver cyanide
(d) all the above

Question 4

At the Oneida Ltd. waste-treatment plant the silver cyanide is reduced to silver chloride by treatment with

(a) ferric chloride
(b) sodium hypochlorite
(c) sulfuric acid
(d) all the above

Question 5

At the Oneida Ltd. plant a continuous waste-treatment process involving pH adjustment, cyanide oxidation, skimmer, thickener, and sand filter is used for the

(a) acid waste
(b) alkali waste
(c) silver cyanide
(d) all the above

Question 6

In the rapid-response thermocouples developed by Purdue University to measure gun-barrel temperatures in firing-time intervals, the bore-surface couples differ from the in-wall couples in that the former effects a hot junction by

(a) electroplated film
(b) pressure contact with barrel
(c) butt weld
(d) constantan wire

Question 7

Instrument personnel training at Armco Steel Corp. comprises

(a) continuous on-the-job training
(b) evening-school classes
(c) instrument-company-managed schools
(d) all the above

Question 8

The Hoopes Conductivity Bridge is a special-purpose bridge for measuring

(a) absolute resistance
(b) absolute capacitance or inductance
(c) percent conductivity referred to a standard
(d) absolute conductivity in units of mhos

Question 9

A flow bean is

(a) a manual valve with calibration
(b) a diaphragm control valve with positioner
(c) an open flume or weir
(d) a flowmeter with pulsation dampener

Question 10

In gas-well instrumentation a flow bean can be used as a bottom-hole choke in order to

(a) protect high-pressure wells
(b) reduce likelihood of freezing
(c) take initial pressure drop
(d) do all the above

Quotient) See Page 146 for Answers

Question 11

In gas-well instrumentation, a flow bean often is used to control gas flow. In order to eliminate effect of downstream pressure, the minimum drop across the flow bean should be
(a) 2 to 1
(b) 4 to 1
(c) 8 to 1
(d) 16 to 1

Question 12

The P.I. of a gas well is its
(a) pressure indication
(b) production index
(c) preliminary inspection
(d) pressure index

Question 13

The P.I. of a gas well can be determined from
(a) flow bean indications of rates
(b) static line pressures and temperatures
(c) bottom hole pressures, shut-in and flowing
(d) any of the above

Question 14

Fluid level between the casing and tubing in a gas well usually is measured by
(a) float technique
(b) pressure technique
(c) sonic technique
(d) capacitive technique

Question 15

In class-A and class-B amplifier operation of transistors, the theoretical upper limit of power efficiency is
(a) 10 percent
(b) 25 percent
(c) 50 percent
(d) 100 percent

Question 16

In class-C operation of transistors, theoretical upper limit of power efficiency is
(a) 10 percent
(b) 25 percent
(c) 50 percent
(d) 100 percent

Question 17

In an oscilloscope the sync system output is applied to the
(a) timebase oscillator
(b) cathode-ray tube
(c) vertical amplifier
(d) horizontal amplifier

Question 18

The Reflectoscope is
(a) an ultrasonic tester
(b) an optical comparator
(c) an optical tester
(d) a delay line

Question 19

The linear variable differential transformer is essentially
(a) an autotransformer
(b) a displacement transducer
(c) a weight transducer
(d) a pressure transducer

Question 20

Accuracy and linearity of a linear variable differential transformer is in the order of
(a) 0.1 percent
(b) 0.5 percent
(c) 2.0 percent
(d) 5.0 percent

Question 21

The lowest-melting-point solder contains approximately
(a) 70% tin, 30% lead
(b) 60% tin, 40% lead
(c) 50% tin, 50% lead
(d) 30% tin, 70% lead

Question 22

Which of the following statements about the "Megger" ohmmeter is NOT true:
(a) The indicator is a permanent-magnet moving-coil type.
(b) A hand-operated generator is used.
(c) Basic use is measurement of high resistance.
(d) Interaction of fields of two coils positions pointer.

Question 23

A barretter is
(a) a bolometer
(b) temperature sensitive
(c) an r-f. power transducer
(d) all the above

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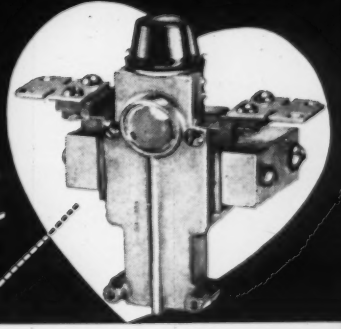

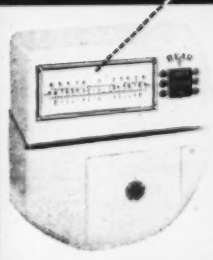

IN THE AUTOMOTIVE FIELD, the Bear Manufacturing Co. of Rock Island, Ill. uses Series 500 G-M Galvanometers in its new remote-reading Electric Wheel Alignment System (left). Whatever your own particular instrument field, you can achieve this same self-contained portability, ruggedness and high sensitivity with G-M Galvanometers. Complete catalog on request.

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For more information circle **126** on inquiry card.

New Literature...

INSTRUMENTS and AUTOMATION

AUTOMATION

D'Arsonval Controller. New 16-page Bulletin G-6 presents, illustrates maker's automatic contact-meter-relay controllers (D'Arsonval movement plus locking relays) for sensitive control of chemical processes or mechanical operations through either alarm and automatic shut off or continuous on-and-off control.—Assembly Products, Inc., Chesterland, Ohio.

Circle **413** on inquiry card.

Electronic Control System. New 54-page Book 789 is basic text covering principles, units, and operation of maker's automatic "inductive" control system. Includes all principles of automatic control techniques and clear description of all components—inductive remote transmitters control amplifier, servomotor, and T-unit.—Hartmann & Braun A. G., Frankfurt/Main, Falkstr. 5, Germany.

Circle **414** on inquiry card.

Pneumatic Transmitter. New 4-page Bulletin 285-L2 describes and illustrates maker's "BalanCel" pneumatic transmitter "Model ATD" for measuring flow, level, and differential pressures in water filtration and sewage plants.—Builders-Providence, Inc., 345 Harris Ave., Providence, R. I.

Circle **415** on inquiry card.

Process Control. New 8-page issue of "Modern Precision" (Vol. 14, No. 2) features articles on control in process industries, quality control, power, research, teaching and testing.—Leeds & Northrup Co., 4907 Stenton Ave., Phila. 44, Pa.

Circle **416** on inquiry card.

pH Control. New 4-page Data Sheet 700 (1) "L&N pH Control of Cooling Tower Water" offers suggestions on measurement and control of the pH of cooling-tower water, and describes maker's equipment for this application.—Leeds & Northrup Co., 444 North 16th St., Phila. 30, Pa.

Circle **417** on inquiry card.

Water, Sewage Control System. New 8-page Bulletin 9100 describes maker's "Telestep" remote-transmission system for water, sewage and process plant uses. Includes principles of five basic models (1-step, 2-step with reporting signal, multiple step and proportional multiple step).—Automatic Control Co., 995 University Ave., St. Paul 4, Minn.

Circle **418** on inquiry card.

Ratio Regulator. New 4-page Bulletin 722 describes maker's ratio regulator for controlling oil burners by varying of pressures.—Hauck Mfg. Co., 124-136 Tenth St., Brooklyn 15, N. Y.

Circle **419** on inquiry card.

Water and Power Control. New 4-page issue of "Autocon Rambler" (Vol. 6, No. 3) feature article on water and power conservation at Fort Ord army training centers.—Automatic Control Co., 1005 University Ave., Saint Paul 4, Minn.

Circle **420** on inquiry card.

Hydraulic Press Control. New 4-page Bulletin MSA-109 describes maker's ring-balance meter for controlling high-pressure hydraulic presses of 2000 psi. and upwards.—Hagan Corp., 323 Fourth Ave., Pgh. 22, Pa.

Circle **421** on inquiry card.

Diaphragm Piston. Three new 2-page data sheets (including Form 200) describe and illustrate maker's flangeless bead-type "Bellofram" piston seals—which use a diaphragm-sealed piston for pressure-sealing applications, and for converting pressure into a long stroke at high thrust levels without mechanical friction.—Bellofram Corp., 144 Moody St., Waltham, Mass.

Circle **422** on inquiry card.

VALVES

Valves. Four new 2-page Data Sheets (1513A10, 1514A10, 1515A10, 1515A11) describes maker's pilot-operated, 4-way valves; single-solenoid-operated, 2- and 4-way valves for hydraulic oil systems; single-solenoid-controlled, pilot-operated, 4-way valves; and double-solenoid-controlled, pilot-operated, 4-way valves.—Parker Appliance Co., 17325 Euclid Ave., Cleveland 12, Ohio.

Circle **423** on inquiry card.

Butterfly Valves. New 4-page Bulletin 650-L1 describes maker's complete line of tight-closing rubber-seat butterfly valves. Includes photographs and detailed descriptions.—Builders-Providence, Inc., 345 Harris Ave., Providence, R. I.

Circle **424** on inquiry card.

Valves. New folder contains engineering drawings of maker's "Semaco" valves with integral molded flange which eliminates pipe gaskets.—Standard Engineering and Machine Co., Inc., Marshallton, Delaware.

Circle **425** on inquiry card.

Valves and Fittings. New 8-page brochure "Stainless-Steel Valves and Fittings in the Pulp and Paper Industry" discusses applications, processes, methods of installation and maintenance. Includes diagrams, illustrations and tables on mechanical properties.—Cooper Alloy Corp., Hillside 5, N. J.

Circle **426** on inquiry card.

SYNCHROS, MOTORS

Synchros. New 4-page folder "How a Synchro Works" describes several types of synchros, their principles, characteristics, and applications.—Ketay Instrument Corp., 555 Broadway, New York 12, N. Y.

Circle **427** on inquiry card.

Frac-hp. Motors. New 4-page Catalog F 4271-5 lists maker's line of unidirectional, synchronous, reversible, and geared-head shaded-pole motors (0.004 to 0.024 hp.) for communication equipment, industrial instruments, etc.—Barber-Colman Co., Small Motors Div., 1200 Rock St., Rockford, Ill.

Circle **428** on inquiry card.

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Motor Application Fundamentals. New 4-page issue of "Motorgram" (Vol. 34, No. 6) features article on application fundamentals, including how to measure starting torque of a machine.—Bodine Electric Co., 2282 W. Ohio St., Chicago 12, Ill.

Circle **429** on inquiry card.

Heavy-duty Motors. New 4-page Folder F-3959-2 lists features and performance characteristics of maker's heavy-duty "Type YAR" motors for pumps, fans, blowers, and industrial controls.—Barber-Colman Co., 1200 Rock St., Rockford, Ill.

Circle **430** on inquiry card.

PM Motor. New 2-page Data Sheet PM36-954 describes maker's permanent-magnet motor "Type PM-36" for high efficiency, good speed regulation, and low r-f. interference.—Dalmotor Co., 1344 Clay St., Santa Clara, Calif.

Circle **431** on inquiry card.

Motors, Compressors, Pumps. New 12-page Bulletin 1054-33 "Original Equipment Application Ideas for Product Designers" presents thirty-five product component problems solved with maker's rotary air motors, air compressors, and vacuum pumps.—Gast Mfg. Corp., Benton Harbor, Mich.

Circle **432** on inquiry card.

TEMPERATURE

Thermostats. New 2-page Bulletin L-9070A describes maker's line of "Type A" thermostats for electronic and avionic devices, appliances and apparatus. Includes performance data and ratings.—Stevens Mfg. Co., Inc., Lexington and Mansfield, Ohio.

Circle **433** on inquiry card.

Portable Potentiometer. New 4-page Bulletin 112 describes maker's "Pyrotest Model 9A" portable potentiometer for checking and calibrating industrial and laboratory temperature instruments.—Technique Assoc., Inc., 211 E. South St., Indianapolis, Indiana.

Circle **434** on inquiry card.

Temperature Control. New 8-page brochure describes and illustrates maker's "Power-O-Matic" control which gives automatic proportional wattage control for straight-line temperature control throughout entire oven range.—Blue M Electric Co., 138th and Chatham St., Blue Island, Ill.

Circle **435** on inquiry card.

Refrigerated Bath. Two new 2-page bulletins describe maker's mechanically-refrigerated bath that provides sensitive temperature control from minus 5 to plus 65 C.—Wilkens-Anderson Co., 4525 W. Division St., Chicago 51, Ill.

Circle **436** on inquiry card.

Temperature Cabinets. New 4-page Bulletin 101 presents maker's 3 types of "Trop-arctic" temperature cabinets "Models TAS-12-120A, TAS-2-120A, and TAU-27-100-WH" for all cold and heat requirements.—Trop-Arctic Temperature Products, 627 S. Mulberry St., Muncie, Ind.

Circle **437** on inquiry card.

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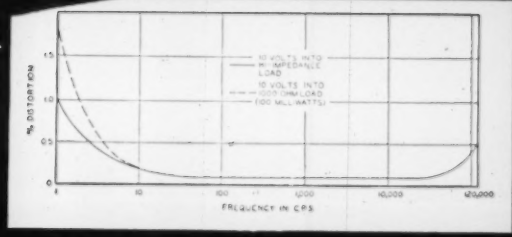

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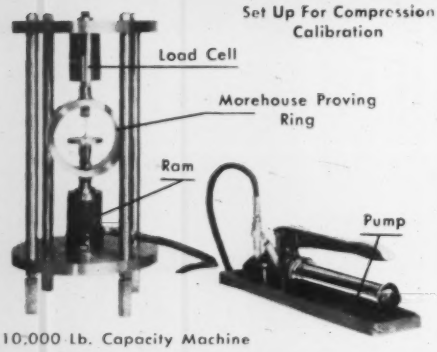

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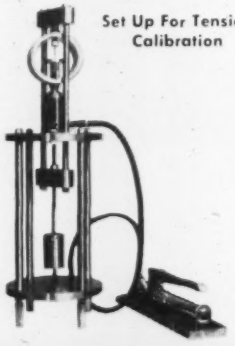

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NEW LITERATURE

Bimetallic Control Switch. New 4-page illustrated bulletin describes maker's new 118- and 236-volt heat-control device for control of furnaces, hot plates, etc.—Proctor Electric Co., 3rd St. & Hunting Park Ave., Phila. 40, Pa.

Circle **438** on inquiry card.

FLOW

Flow Meters. New 12-page Bulletin M22-5 describes and illustrates maker's open-channel meters for sewage, industrial wastes, sludge, irrigation for water supply and waste treatment applications in industrial plants.—Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland 10, Ohio.

Circle **439** on inquiry card.

Positive Flow Meters. New 8-page Bulletin 567 describes and illustrates maker's industrial liquid meters including "Auto-stop" quantity control, "Auto-switch" and "Print-o-meters."—Neptune Meter Co., 19 W. 50th St., New York 20, N. Y.

Circle **440** on inquiry card.

STRAIN, PRESSURE

Stress-Strain Recorders. New 28-page Bulletin 4215 covers principles and applications of maker's 16 standard recorders and 50 models of strain followers for use on Baldwin and other testing machines. Includes basic test setups and block diagram discussions of basic applications.—Baldwin-Lima-Hamilton Corp., Phila. 42, Pa.

Circle **441** on inquiry card.

Pressure, Weight. New 4-page Bulletin M-15 "Heavy-Duty Weight and Tension-Indicating Instruments" presents maker's hydraulic materials handling equipment, hook scales, tensiometers, crane weight indicators, lift-truck scales, logweighers, load cells, etc.—Martin-Decker Corp., 3431 Cherry Ave., Long Beach 7, Calif.

Circle **442** on inquiry card.

COMBUSTION

Smoke and Combustion Control. New 8-page Bulletin 532 describes maker's "Electric Eye" photoelectric instruments for detection and control of smoke and haze.—ESS Instrument Co., 96 S. Washington Ave., Bergenfield, N. J.

Circle **443** on inquiry card.

Furnace Control. New 4-page Bulletin SC-168 describes "Autocarb" system for automatic carbon control of heat-treat furnace atmospheres.—Surface Combustion Corp., Toledo, Ohio.

Circle **444** on inquiry card.

Fuel Oil Blender. New 4-page Bulletin L-25 "The Continuous Blending and Proportioning of Fuel Oils" contains diagrams and descriptions of maker's newly-developed two-component blender that automatically delivers a blend of No. 5 fuel oil into tank

R1040-6 SERVOMETER

trucks, tank cars, ships or storage.—Proportioneers, Inc., 345 Harris Ave., Providence, R. I.

Circle **445** on inquiry card.

Inert Gas Equipment. New 20-page Bulletin G-10 "Kemp Case Histories" features on-the-spot photographs and installations of inert gas generating equipment at 17 major companies. C. M. Kemp Mfg. Co., 405 E. Oliver St., Baltimore 2, Md.

Circle **446** on inquiry card.

SPEED

Tachometers. New 4-page Bulletin 770A describes maker's "Standco" vibrating-reed tachometers with one rotating element which is completely enclosed.—Herman H. Sticht Co., Inc., 27 Park Place, New York 7, N. Y.

Circle **447** on inquiry card.

Tachometers. New 2-page "Case History 3" describes maker's tachometers and speed reducers for making rpm. for hp. calculations on a V-belt testing apparatus.—Metron Instrument Co., 432 Lincoln St., Denver 3, Colo.

Circle **448** on inquiry card.

AIR, MOISTURE

Wind Velocity Recorder. New set of 2-page bulletins illustrate maker's wind velocity recorder for applications such as air pollution research, weather stations, public gas industries, etc.—Hastings Instrument Co., Inc., HICO Instruments Div., Warwick, Va.

Circle **449** on inquiry card.

Moisture Measuring Instrument. New 2-page bulletin describes maker's "Hygrotester-Boy," a portable dielectric moisture-measuring instrument for pulp, paper, board, cellophane, etc. —Hygrotester, Inc., 101 Henry St. at Clark St., Brooklyn 1, N. Y.

Circle **450** on inquiry card.

Rapping System. New 6-page bulletin describes maker's "MI-Rapper" for automatic and continuous cleaning of collection electrodes in an electrostatic precipitator. Includes operating principles and components.—Research-Cottrell, Inc., 405 Lexington Ave., New York 17, N. Y.

Circle **451** on inquiry card.

TRANSDUCERS

Transducers, Components. New 8-page booklet describes and illustrates accelerometers, filters, amplifiers, transducers, capacitors, resistors, thermistors, voltmeters, generators, analyzers, ammeters, etc., manufactured by companies associated with.—Gulton Industries, Inc., 212 Durham Ave., Metuchen, N. J.

Circle **452** on inquiry card.

Displacement Transducer. New technical application notes (14 pages) describe "Lyn-A-Syn" linear-motion displacement transducer for precise sensing of rectilinear motion, testing, and displacement due to pressure, weight, liquid level, expansion, etc.—Minatron Corp., Belle Mead, N. J.

Circle **453** on inquiry card.

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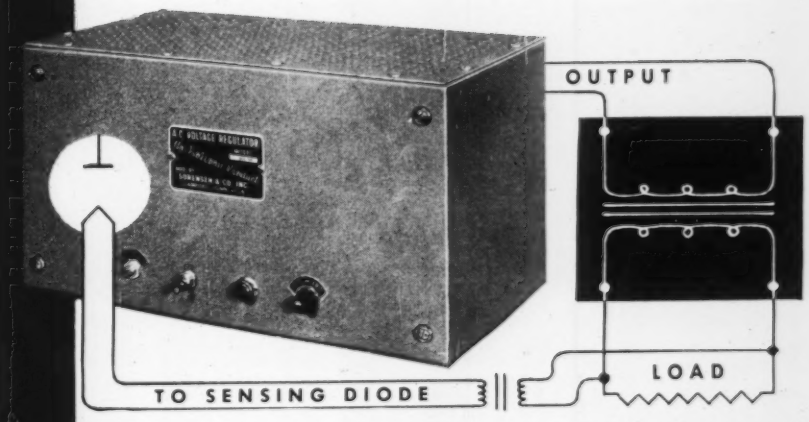

This schematic illustrates a typical external sensing regulator application. It might be very useful, for example, in a situation where the load must be located at a distance from the regulator, causing unsatisfactory load voltage regulation because of line drop in the feeder line as the current varies.

A transformer is used to match the load voltage to the value of 2.5 volts required by the diode control circuit of the regulator.

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(tubeless) — 6, 28 VDC at 5, 40, 50 amperes.

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SPECIAL DEVELOPMENTS: Sorensen engineers are thoroughly familiar with the latest techniques utilizing transistor control and magnetic sensing. They are accustomed to working with germanium rectifiers as well as selenium, and are versed in power control techniques other than those used in the standard Sorensen instruments. They are, therefore, in a favorable position to design power supplies along whatever lines you prefer for incorporation in your equipment.

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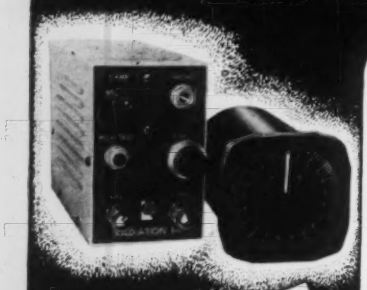
For more information circle **131** on inquiry card.

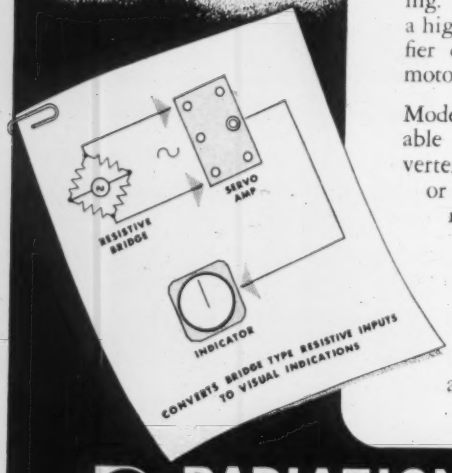
R1040-6 SERVOMETER



The R-1040-6 Servometer accepts resistive bridge type inputs from accelerometers, pressure gages, and mechanical force dynamometers, and converts bridge unbalance to linear dial displacement for visual or photographic recording. This is accomplished through a high-gain nonlinear servo amplifier driving an indicator servo motor.

Models of these systems are available with analog-to-digital converters for digital recording and/or remote transmitters for remote indicators.

Perhaps the R-1040-6 is the answer to your research or test instrumentation problems. Your inquiries are cordially invited.



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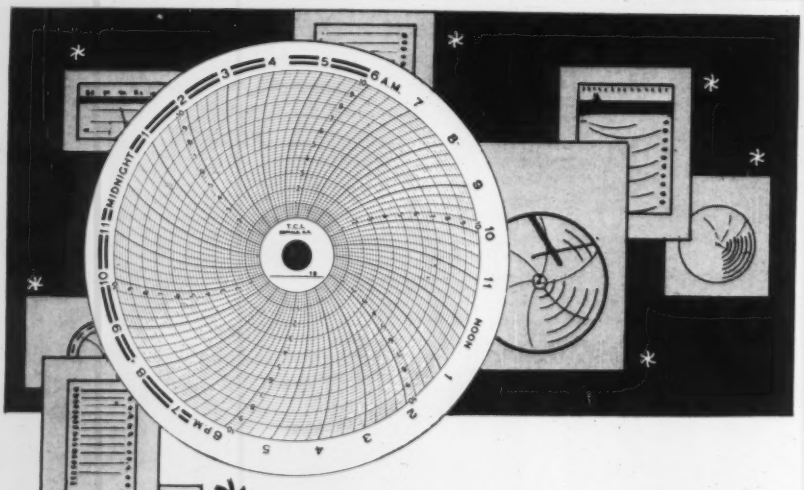

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NEW LITERATURE

RECORDING

Tape Recording. New 11-page Bulletin 54-D describes maker's magnetic-tape data-recording equipment for data recording, reproduction, and analysis, process control, etc.—Davies Laboratories, Inc., 4705 Queensbury Rd., Riverdale, Md.

Circle **454** on inquiry card.

Electronic Plotter. New 8-page Bulletin TC-103 describes and illustrates maker's "Teleplotter" for automatically transcribing and analyzing experimental data in graphical form.—Telecomputing Corp., Burbank, Calif.

Circle **455** on inquiry card.

Recording Systems. New 6-page Brochure 60M describes and illustrates maker's "150" oscillographic recording systems with a dual-channel d-c. amplifier for measuring and recording two separate single-ended signals, at sensitivities between one and one hundred volts per centimeter.—Sanborn Co., 195 Massachusetts Ave., Cam bridge 39, Mass.

Circle **456** on inquiry card.

TAPE HANDLERS

Paper-Tape Readers. New 2-page Bulletin TF-3 describes and illustrates maker's paper-tape readers for data processing and control systems; including "Model FR-350" dual-paper-tape reader for simultaneous reading of two perforated paper-tapes of either 5, 6 or 7 levels; and "Model FR-310" single-paper-tape reader for readings of 5, 6, 7, or 8 level perforated paper tapes.—Soroban Engineering, Inc., Box 117, Melbourne, Fla.

Circle **457** on inquiry card.

Tape Converter. New 2-page Data Sheet SP-8609 describes and illustrates maker's "Model 265" tape converter for converting a six-channel tape into an equivalent five-channel tape used for wire transmission with existing five-channel transmitter distributor and reperforation equipment.—Commercial Controls Corp., Rochester 2, N. Y.

Circle **458** on inquiry card.

DATA ANALYSIS

Digitizer. New 4-page Bulletin CR 167 and 2-page Bulletin CR-165 describe and illustrate maker's Digitizer, an electromechanical device for converting rotating shaft position into decimal form.—Coleman Engineering Co., Inc., 6040 W. Jefferson Blvd., Los Angeles 16, Calif.

Circle **459** on inquiry card.

Data Analyzer, Digitizer. New 4-page Bulletin TC-102 describes maker's "Telecordex," a dual-indicating and recording accumulator for counting and storing sequential electrical pulses.—Telecomputing Corp., Burbank, Calif.

Circle **460** on inquiry card.

Scanner, Digitizer. New 4-page Bulletin 104-1 describes and illustrates maker's "Teleducer" analog-to-digital converter for automatic digital voltage measurement, automatic process and quality control, automatic tolerance testing, etc.—Telecomputing Corp., Burbank, Calif.

Circle **461** on inquiry card.

Data Analysis. New 8-page folder describes maker's "Telereadex 29A" for rapid analysis of tests recorded on motion-picture film.—Telecomputing Corp., 1054 Wilshire Blvd., Los Angeles 17, Calif.

Circle **462** on inquiry card.

COMPUTERS

Computer Blocks. New 4-page illustrated Bulletin 180-B1 describes maker's unitized blocks for computer memory, clock pulse generator, amplifier, etc.—Technitrol Engineering Co., 2751 N. 4th St., Phila. 33, Pa.

Circle **463** on inquiry card.

Analog Computer. New 2-page data sheet describes maker's "Model MU" analog multiplier.—George A. Philbrick Researches, Inc., 230 Congress St., Boston 10, Mass.

Circle **464** on inquiry card.

OPTICAL

Photo Equipment. New 96-page 55th annual Catalog 154-K illustrates complete line of photo equipment, adapters, portrait cameras, slide projectors, tape recorders, negative preserves, exposure meters, etc., for commercial, scientific and industrial uses.—Burke & James, Inc., 321 S. Wabash Ave., Chicago 4, Ill.

Circle **465** on inquiry card.

Optical Instruments. New 20-page catalog describes and illustrates maker's line of telescopes, telescope kits, binoculars, microscopes, scientific toys, thermometers, etc.—Edmund Scientific Corp., 101 E. Gloucester Pike, Barrington 6, N. J.

Circle **466** on inquiry card.

Daylight Illuminometer. New 2-page Data Sheet E-ND46 describes maker's "Speedomax" daylight illuminometer recorder for automatically recording daylight intensity.—Leeds & Northrup Co., 4934 Stenton Ave., Phila. 44, Pa.

Circle **467** on inquiry card.

Contact Printer. New 2-page bulletin describes and illustrates maker's "Vari lamp" for enlarging and contact printing; "Varicon" for contact printing "Varigam" without filters.—Aristo Grid Lamp Products, Inc., 106-23 Metropolitan Ave., Forest Hills, N. Y.

Circle **468** on inquiry card.

Color Difference Meter. New 4-page issue of "Newsletter" (Vol. 1, No. 7) describes and illustrates maker's color difference meter for rapid and direct determination of hue, value and chroma upon three potentiometer dials.—Gardner Laboratory, Inc., Bethesda 14, Md.

Circle **469** on inquiry card.

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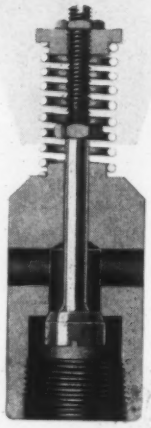

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NEW LITERATURE

ANALYTICAL

Spectrograph. New 8-page Catalog EB 10-54 describes and illustrates maker's plane-grating spectrograph with order sorter for analytical and research applications.—Jarrell-Ash Co., 26 Farwell St., Newtonville, Mass.
Circle **470** on inquiry card.

Spectrophotometer. New 4-page Bulletin CH370/M presents British-made "Uvispek photoelectric spectrophotometer "Series 304" for identifying and estimating a wide range of substances and their constituents; (coloring agents in dyes, paints and pigments, etc.).—Jarrell-Ash Co., 26 Farwell St., Newtonville 60, Mass.
Circle **471** on inquiry card.

Electron Microscopy. New 2-page bulletin describes a bibliography from 1950-53 of world literature of electron microscopy on over 1000 edge-notched keysort cards.—New York Society of Electron Microscopists, 2 East 63rd St., New York 21, N. Y.
Circle **472** on inquiry card.

LABORATORY EQUIPMENT

Trends in Research. New 24-page brochure discusses growth and features of laboratory and scientific quality control, research and development. Includes data on purchasing of instruments, chemicals, etc. Price 25c.—Scientific Apparatus Makers Association, 20 North Wacker Drive, Chicago 6, Ill.
Circle **473** on inquiry card.

Scientific Equipment. New 20-page issue of "Announcer" (No. 54-11-56) features information on triple-beam balances, colorimeter-spectrometer, "Kup-L-Weld" for making thermocouples in laboratories, and "Kwik-Chek" gas analyzers.—Burrell Corp., 2223 Fifth Ave., Pgh. 19, Pa.
Circle **474** on inquiry card.

Laboratory Balance. New 4-page booklet describes and illustrates maker's "Cent-O-Gram Model CG311" triple-bean balance with a capacity of 311 gram.—Ohaus Scale Corp., Union, N. J.
Circle **475** on inquiry card.

Laboratory Instruments. New 8-page Brochure P-1154 lists maker's complete line of polyethylene laboratory items—Scientific Glass Apparatus Co., Inc., Bloomfield, N. J.
Circle **476** on inquiry card.

Laboratory Equipment. New 16-page booklet "What's New for the Laboratory" describes and illustrates thermometer adapter, water demineralizer, ovens, etc.—Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.
Circle **477** on inquiry card.

TESTING, INSPECTION

Hardness Tester. New 4-page bulletin describes characteristics and use

of maker's hardness tester for superficial and regular range of Rockwell testing.—Torsion Balance Co., Clifton, N. J.

Circle **478** on inquiry card.

Gear Checkers. New 4-page Bulletin MIC-54 describes maker's line of "Sine-Line" involute-gear checkers. Includes operating details and specifications for entire 14-model line.—Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.

Circle **479** on inquiry card.

Magnetic Testing. New 8-page Booklet RC-135 describes maker's "Portaflux" portable magnetic-particle test unit for checking ferrous metal objects for surface discontinuities.—Mount Vernon Div., North American Philips Co., Inc., 750 S. Fulton Ave., Mount Vernon, N. Y.

Circle **480** on inquiry card.

Grease Tester. New 2-page Data Sheet 11490 describes maker's "Mil-Shell" roll-grease tester for measuring tendency of lubricating greases to liquify while in service.—Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.

Circle **481** on inquiry card.

GAGING

Optical Comparator. New 4-page folder describes maker's duplex shadowgraph comparator for use on production or assembly lines, tool rooms, etc.—Portman Instrument Co., Town Dock Rd., New Rochelle, N. Y.

Circle **482** on inquiry card.

Air Gaging. New 4-page illustrated folder describes maker's reconditioning service for worn or obsolete air gaging members.—Freeland Gauge Co., 9940 Freeland Ave., Detroit 27, Mich.

Circle **483** on inquiry card.

GRAPHIC CIRCUITS

Etched Circuitry. New 2-page bulletin describes and illustrates maker's packaged etched circuitry and lists output, distortion, size, base, power requirements, etc. of all models.—Audio Products Corp., 2265 Westwood Blvd., Los Angeles 64, Calif.

Circle **484** on inquiry card.

Etched Circuits. Two new 2-page Data Sheets (130 and 131) describe maker's etched circuits for electronic circuits, i-f. strips, terminal boards, etc.; also maker's custom-built cabinets and cases.—Hastings Instrument Co., Inc., HICO Instruments Div., Warwick, Va.

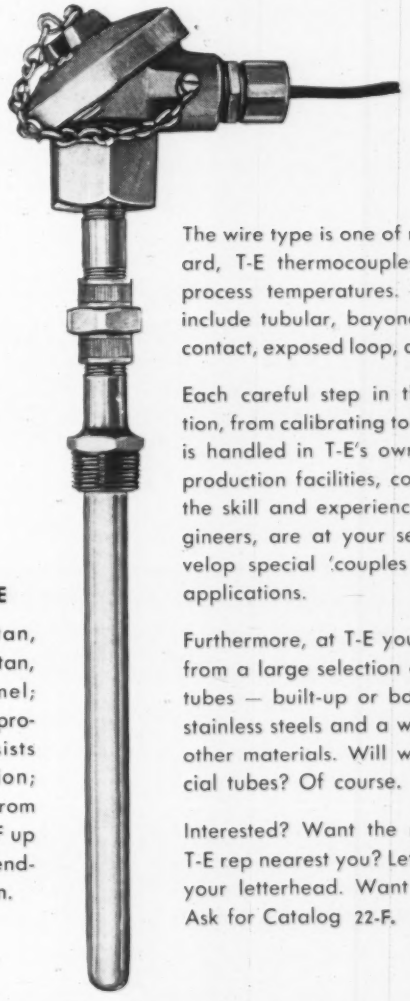
Circle **485** on inquiry card.

Printed Circuitry. New 12-page bulletin "Mechanize Your Wiring With Copper-Clad Phenolite" covers basic technical facts, design data related to applied printed circuitry and methods of producing printed circuits.—National Vulcanized Fibre Co., Wilmington 99, Delaware.

Circle **486** on inquiry card.

DOES THERMO ELECTRIC MAKE WIRE TYPE THERMOCOUPLES?

CERTAINLY. TRY AND NAME A THERMOCOUPLE T-E DOESN'T MAKE.



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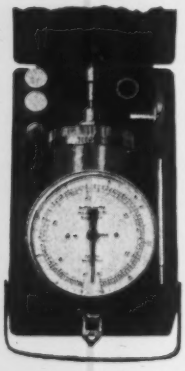

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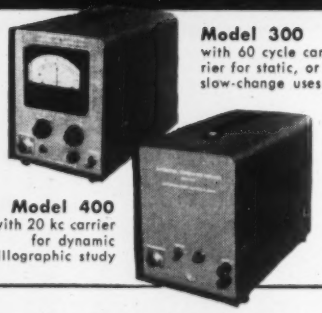

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NEW LITERATURE

Etched Circuits. New 4-page Bulletin H-3-38 describes uses of maker's new high-speed, sensitive, plastic coating for making etched circuits.—Graphic Arts Sales Div., Eastman Kodak Co., Rochester 4, N. Y.

Circle **487** on inquiry card.

ELECTRONIC, ELECTRICAL INSTRUMENTS

Electronics Dictionary. New 72-page edition of "A Dictionary of Electronic Terms" (37 K 756) contains 3,500 terms used in television, radio and industrial electronics. Includes 150 illustrations and diagrams of components, equipment, and electronic circuits. Price 25c.—Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill.

Circle **488** on inquiry card.

Electrometers. New 12-page catalog describes maker's vacuum tube electrometers and accessories used as millivoltmeters, voltmeters, kilovoltmeters, milliammeters, microammeter, d-c. preamplifiers, etc. Includes electrometer characteristics and circuit discussion.—Keithley Instruments, 3868 Carnegie Ave., Cleveland 15, Ohio.

Circle **489** on inquiry card.

Generators, Oscilloscopes. Two new 4-page Booklets (8A and 8B) describe maker's VHF-UHF marker, signal generators, oscilloscopes, tube tester.—Hickok Electrical Instrument Co., 10514 Dupont Ave., Cleveland 8, Ohio.

Circle **490** on inquiry card.

Current Transformer Testing. New 2-page Data Sheet E-51(1) describes maker's "Silsbee" test set for testing current transformers.—Leeds & Northrup Co., 4934 Stenton Ave., Phila. 44, Pa.

Circle **491** on inquiry card.

Electronic Instruments. New 36-page Catalog D presents maker's line of oscillators, filters, power supplies, and amplifiers. Includes 5 pages of tables—reactance tables, db tables, and transfer functions.—Krohn-Hite Instrument Co., 580 Massachusetts Ave., Cambridge 39, Mass.

Circle **492** on inquiry card.

Magnetic Amplifiers. New 4-page "Power Supply Bulletin PSB-454" contains articles concerning latest advances in fields of magnetic amplifiers and power supplies.—Perkin Engineering Corp., 345 Kansas St., El Segundo, Calif.

Circle **493** on inquiry card.

Multirange DC Instrument. New 4-page issue of "Electrical Measurements" (Vol. 21, No. 7) describes and illustrates maker's "Poly-Ranger Model C" with scale length of 6.3 inches and an accuracy of 0.25 percent.—Sensitive Research Instrument Corp., Mount Vernon, N. Y.

Circle **494** on inquiry card.

Volt-amp-ohmmeters. New 2-page Bulletin P555M-1 describes maker's "555" shielded, shatterproof, anti-magnetic, metal-cased multimeters.—Phaostron Co., 151 Pasadena Ave., South Pasadena, Calif.

Circle **495** on inquiry card.

Calibration Standard. New 6-page leaflet describes and illustrates maker's "Model 829" instrument calibration standard for calibration of electrical instruments.—Radio Frequency Labs., Inc., Boonton, N. J.

Circle **496** on inquiry card.

Calibration Standards, Magnet Charger. Four new 2-page bulletins describe maker's "Model 107A" magnet charger for charging all kinds and shapes of permanent magnets; "Model 454" a-c. instrument calibration standard for calibrating a-c. voltmeters, ammeters, etc.; "Model 261B" a-c. instrument calibration standards; "Model 262B" dual-potentiometer calibration standard for calibrating electrical measuring instruments.—Radio Frequency Labs., Inc., Boonton, N. J.

Circle **497** on inquiry card.

Complex-Plane Analyzer. New 6-page issue of "Laboratory Reports #14" describes maker's complex-plane analyzer for determining field patterns, synthesizing antenna arrays, and studying pattern behavior.—Technology Instrument Corp., 531 Main St., Acton, Mass.

Circle **498** on inquiry card.

Generator. New 2-page bulletin describes maker's time-mark generator "Type 181" which generates 1 to 10,000 usec. markers and a 10 Mc. sine wave at an output amplitude of approximately 3.0 volts.—Tektronix, Inc., P. O. Box 831, Portland 7, Oregon.

Circle **499** on inquiry card.

Circuit Testing. New 20-page issue of "Capacitor" (Vol. 19, No. 11) Nov., 1954 features article on use of square waves in testing.—Cornell-Dubiler Electric Corp., Hamilton Blvd., S. Plainfield, N. J.

Circle **500** on inquiry card.

Electronic Kit. New 4-page folder describes and illustrates maker's 1-tube radio kit "Model T-100" consisting of 23 different items for learning basic circuits.—Science Electronics, Inc., 485 Main St., Cambridge, Mass.

Circle **501** on inquiry card.

Missile Test Equipment. New 4-page folder describes maker's aerial reconnaissance cameras, guided missile and field service test equipment, ordnance products and aerial surveys.—Hycon Mfg. Co., 2961 E. Colorado St., Pasadena 8, Calif.

Circle **502** on inquiry card.

Microwave Analyzer. Five new 2-page Data Sheets (25L1-2, 20S1-2, 24C1-2, 25X2-2, and 25X-1-1) describe and illustrate maker's microwave analyzer SA25 with five interchangeable r-f. heads to cover bands from 800 to 10,250 Mc.—Vectron, Inc., 400 Main St., Waltham 54, Mass.

Circle **503** on inquiry card.

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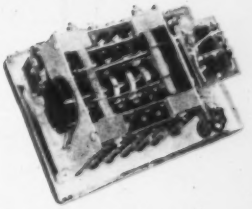

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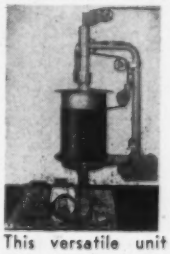

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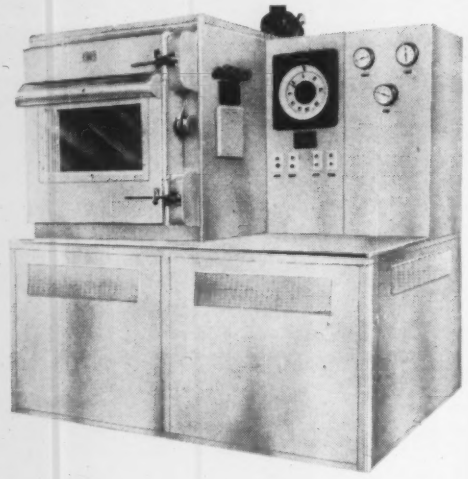

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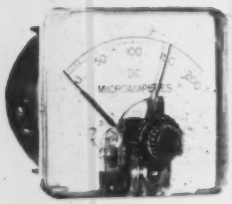

RANGES:

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The trip point is adjustable to any point on the scale arc. These meter-relays are sensitive to changes of as little as 1%. One contact is carried on moving pointer. The other is on a semi-fixed pointer. When two pointers meet contacts close and lock. Holding coil is wound directly over moving coil. Reset can be manual or automatic. Spring action in contacts kicks them apart forcefully. Three sizes of clear plastic case models, 2½, 3¾ and 4½ inches (all rectangular). Two ruggedized and sealed models, 2½ and 3½ inches (round metal cases). Contact arrangements: High Limit Single, Low Limit Single or Double (both high and low). Contact rating is 5 to 25 milliamperes D.C.

Suggested circuits for meter-relays and complete specifications including prices are covered in new 16-page Bulletin G-6, which you can get by writing Assembly Products, Inc., Chesterland 10, Ohio.

For more information circle **146** on inquiry card.

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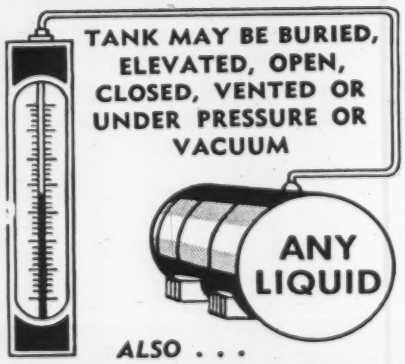

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For more information circle **147** on inquiry card.

NEW LITERATURE

Oscillators. New 8-page issue of "The Experimenter" (Vol. 29, No. 6) features articles on maker's motor drives for frequency dials and beat-frequency oscillators.—General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.

Circle **504** on inquiry card.

Leakage Tester. New 2-page illustrated bulletin describes maker's "Model E-1578" tube insulation and leakage tester for testing leakage resistance of tube elements.—Eder Engineering Co., Inc., 1568 S. First St., Milwaukee 4, Wisc.

Circle **505** on inquiry card.

Dosimeter Kit. New 2-page Bulletin D-3 describes and illustrates maker's "Model L-21K" dosimeter kit for detection of radiation.—Landsverk Electrometer Co., 550 W. Garfield Ave., Glendale 4, Calif.

Circle **506** on inquiry card.

POWER SUPPLIES

Power Supplies. Two new 2-page data sheets describe (1) maker's line of tubeless regulated power supplies and dual transistor supplies for all transistor and low voltage applications and (2) "Transpac" miniaturized power packs for transistor, vacuum tube, and standard applications.—Electronic Research Associates, Inc., Box 29, Caldwell, N. J.

Circle **507** on inquiry card.

Voltage Regulator. New 4-page Bulletin T-8300 describes and illustrates maker's "RX60" voltage regulator for controlling excitation and maintaining constant output voltage of 60-cycle alternators.—Inet Div., Leach Corp., 4441 Santa Fe Ave., Los Angeles 58, Calif.

Circle **508** on inquiry card.

Battery Application Guide. New "Yardney Silvercel Application Guide" aids in selection of most suitable cell for your purpose.—Yardney Electric Corp., New York 7, N. Y.

Circle **509** on inquiry card.

Answers to I.Q. Quiz on page 134

1.—b	9.—a	17.—a
2.—d	10.—d	18.—a
3.—d	11.—a	19.—b
4.—b	12.—b	20.—b
5.—b	13.—c	21.—b
6.—a	14.—c	22.—a
7.—d	15.—c	23.—d
8.—c	16.—d	

Selenium Rectifiers. New 4-page Bulletin 6.401 describes maker's high-temperature selenium rectifiers. Includes 86 types and sizes of high-temperature rectifier cells, their d-c. output ratings in various single- and three-phase circuits.—Fansteel Metallurgical Corp., North Chicago, Ill.

Circle **510** on inquiry card.

Storage Batteries. New 16-page issue of "Storage Battery Power" (Vol. 24, No. 6) features articles on materials handling methods utilizing maker's storage batteries.—Thomas A. Edison, Inc., Edison Storage Battery Div., West Orange, N. J.

Circle **511** on inquiry card.

TRANSISTORS, COMPONENTS

Transistors. New 2-page Bulletin D1-S 426 lists maker's semiconductor devices, silicon transistors for high ambient temperatures and silicon-junction diodes for low-frequency applications.—Texas Instruments, Inc., Semiconductor Products Division, 6000 Lemmon Ave., Dallas 9, Texas.

Circle **512** on inquiry card.

Transistors. New 2-page Bulletin E-240 describes maker's junction transistors HA-1, -2, -3, -8, -9, and -10.—CBS-Hytron, Danvers, Mass.

Circle **513** on inquiry card.

Selenium Diodes. New 4-page issue of "International Rectifier News" (RN-854) describes maker's selenium rectifiers and their industrial application. Includes data sheet on subminiature selenium diodes.—International Rectifier Corp., 1521 Grand Ave., El Segundo, Calif.

Circle **514** on inquiry card.

Transmitting Tube. New 4-page bulletin describes maker's "PL-6549" beam pentode for medium-power a-f. and r-f. applications.—Penta Laboratories, Inc., 312 N. Nopal St., Santa Barbara, Calif.

Circle **515** on inquiry card.

Multiturn Potentiometers. New 4-page Application Data Sheet 102 describes use of maker's multiturn potentiometers in the VAREC electronic gage system used in pipeline operations. Includes principles and circuitry of gaging system.—Helipot Corp., 916 Meridian Ave., South Pasadena, Calif.

Circle **516** on inquiry card.

Receptacles. New 2-page Bulletin 2399 presents maker's hermetic-seal receptacles "Series 172" available in complete glass insert or individual glass contact bead.—American Phenolic Corp., Chicago 50, Ill.

Circle **517** on inquiry card.

Pulse Transformers. New 2-page Data Sheet T-36A describes maker's plug-in pulse transformers that are interchangeable, humidity-resistant and feature four windings.—Berkshire Laboratories, 508 Beaver Pond Rd., Lincoln, Mass.

Circle **518** on inquiry card.

Toroid Coils. New 4-page Bulletin STP describes maker's toroid coils available in cased, uncased and Type

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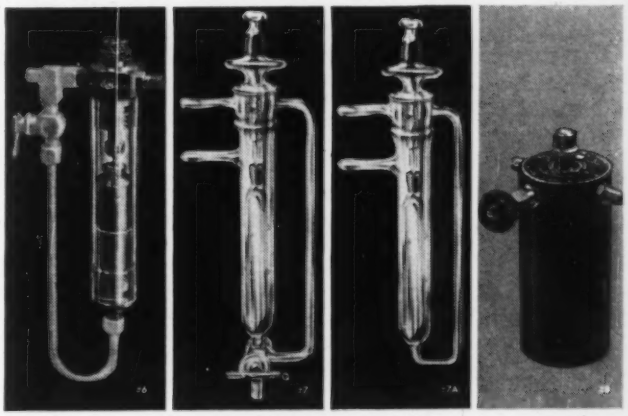

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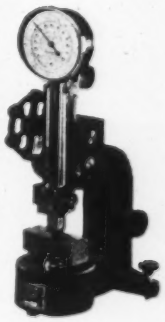

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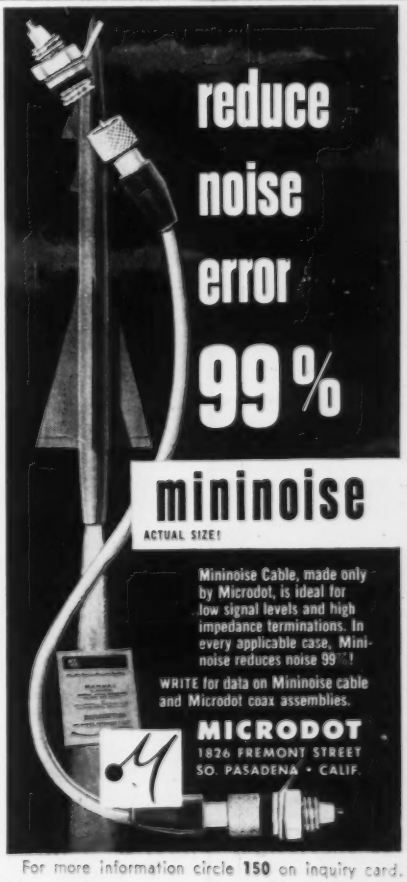
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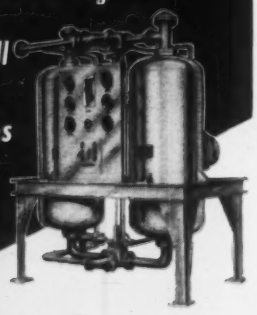

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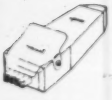

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"p" plastic encapsulated forms. Includes general characteristics and specification charts.—Hycor Co., Inc., 11423 Vanowen St., N. Hollywood, Calif.

Circle **519** on inquiry card.

Transformers, Toroids. New 16-page catalog describes and illustrates maker's transformers, universals, toroids, filters and plug-in housings. Includes 2-page price list.—Dietz Design & Mfg. Co., Grandview, Mo.

Circle **520** on inquiry card.

RELAYS

Relays, Actuators. New 42-page loose-leaf bound catalog describes and illustrates maker's complete line of "Phil-Trol" relays and actuators for electronic control, traffic signals, radio, communications, aircraft, radar, microwave systems, computers, etc.—Phillips Control Corp., Joliet, Ill.

Circle **521** on inquiry card.

Contactors, Switches. New 8-page bulletin describes and illustrates maker's complete line of automatic control equipment, automatic transfer and remote control switch, magnetic contactor, program timers, etc.—Zenith Electric Co., 152 W. Walton St., Chicago 10, Ill.

Circle **522** on inquiry card.

Time Delay Relays. New 12-page Booklet PB-310 describes maker's complete line of time delay relays for panel mounting and built-in applications. Includes load circuit operating tables, time ranges, dimension drawings, etc.—R. W. Cramer Co., Inc., Centerbrook, Conn.

Circle **523** on inquiry card.

Relays. New 4-page Folder 10M354 lists maker's complete line of a-c. and d-c. sensitive relays.—Sigma Instruments, Inc., 170 Pearl St., S. Braintree, Boston 85, Mass.

Circle **524** on inquiry card.

FABRICATION

Lathes, Presses, Drills. New 36-page Catalog M describes and illustrates maker's precision lathes for second operations manufacturing, tool making, etc.; micro-drill presses for very small hole drilling; micro-drills and watchmakers' tools.—Louis Levin & Son, Inc., 3610 S. Broadway, Los Angeles 7, Calif.

Circle **525** on inquiry card.

Lathes. New 8-page Bulletin 5436 describes and illustrates maker's large-swing and quick-change gear lathes for boring jig plates, turning and boring wheels, machining pulleys, etc.—South Bend Lathe Works, 425 E. Madison St., South Bend 22, Ind.

Circle **526** on inquiry card.

Manufacturing Facilities. New 22-page folder describes maker's facilities for manufacture of communica-

Correction

Streeter-Amet Company presented a miniaturized recording digital counter in advertisement No. 101 in the December issue of *Instruments & Automation*. However, rate at which it accepts pulses was not correctly stated. This rate is 1000 cpm., not 100.

tion receivers and transmitters, servo amplifiers, building blocks, infrared glass, pyrometers, recording amplifier, etc.—Servo Corp. of America, 20-20 Jericho Turnpike, New Hyde Park, N. Y.

Circle **527** on inquiry card.

Soldering Iron Tips. New 2-page Bulletin HT describes maker's "Hexclad" tips which deliver uniform heat for uniform joints.—Hexacon Electric Co., 161 W. Clay Ave., Roselle Park, N. J.

Circle **528** on inquiry card.

Stampings. New 4-page Bulletin 201 describes and illustrates maker's short-run stampings for drilling, tapping, stenciling, piercing, blanking, etc., and methods of cutting down cost of stampings.—Federal Tool & Manufacturing Co., 3600 Alabama Ave., Minneapolis 16, Minn.

Circle **529** on inquiry card.

Cabinets, Bins. New 16-page Folder 191 describes and illustrates maker's line of "Little Gem" fabricated steel, storage drawer cabinets; lockers; benches; tool toters and stands; steel trucks; etc.—Precision Equipment Co., 3670 Milwaukee Ave., Chicago 41, Ill.

Circle **530** on inquiry card.

Cutting Tools. New 2-page Bulletin describes maker's line of precision cutting tools including tapered reamer, step reamer, boring tool, recessing tool, counterbore, step drill, mill, countersink, trepan, and hollow mill.—Woodruff & Stokes Co., Inc., 345 Lincoln St., Hingham, Mass.

Circle **531** on inquiry card.

Wire Flattening. New 8-page Bulletin 216 presents maker's theory and practice on wire flattening. Includes discussion on design and operation of modern, high-speed mill equipment.—Stanat Mfg. Co., 47-28 37th St., Long Island City 1, N. Y.

Circle **532** on inquiry card.

Heat-Impulse Sealer. New 2-page Bulletin HS954 describes maker's "Ectromag" heat-impulse sealer with magnetic-bar pressure device for automatically holding plastic product being sealed.—Electronic Processes Corp., 1136 San Antonio Rd., Los Altos, Calif.

Circle **533** on inquiry card.

Mining Tools. New 16-page Catalog C 10 lists maker's complete line of cutting and drilling bits for coal industry, cutter and finger bits, etc.—Allegheny Ludlum Steel Corp., 2020 Oliver Bldg., Pgh. 22, Pa.

Circle **534** on inquiry card.

Die Castings. New 4-page bulletin describes maker's zinc die-casting process which makes it possible to produce small quantities of die castings economically.—Page & Hall Mfg. Co., Inc., 1249 Farmington Ave., W. Hartford 7, Conn.

Circle **535** on inquiry card.

Welding. New 4-page "Weld-It" Booklet 5411 describes and illustrates flash-butt welding tubular premachined forgings for aircraft landing struts. Also shows welder's electronic

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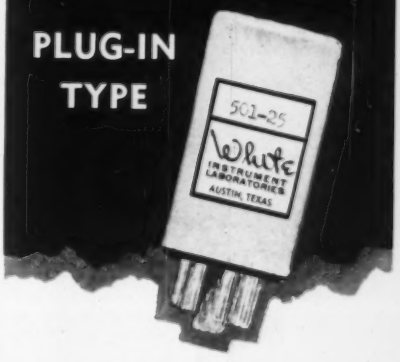

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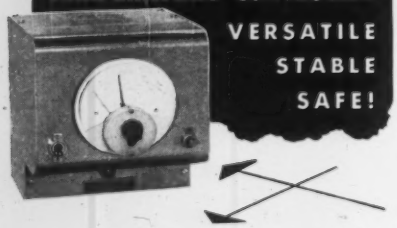

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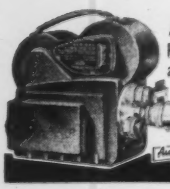

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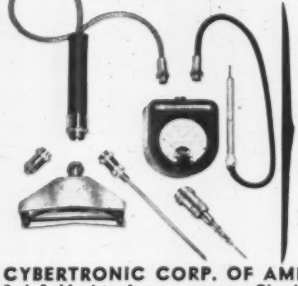

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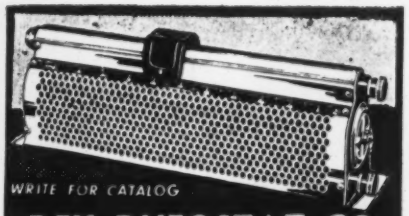

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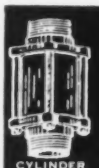

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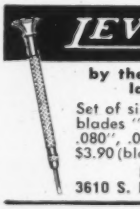

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NEW LITERATURE

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Dielectric Heating. New 2-page bulletin illustrates maker's high-frequency generator with accurately rated output and single dial selector for a complete range of heat-sealing capacity.—Industron Corp., 50 Brook Rd., Needham Heights 94, Mass.
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Cabinets, Chassis. New 4-page Bulletin 532-E illustrates maker's complete line of brackets, cabinets, chassis, dial plates, dust covers, panels, etc.—Multi-Metal Wire Cloth Co., Inc., 1350 Garrison Ave., New York 59, N. Y.
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MATERIALS

Precision Strip. New 4-page Bulletin 5 presents description of precision-rolled beryllium copper, phosphor bronze, nickel silver, chromium copper and copper strip.—Penn Precision Products, Inc., 501 Crescent Ave., Reading, Pa.
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Relay Steels. New 12-page Brochure EM 26 describes and illustrates maker's relay steels for armatures, solenoids, relays, magnetic clutches, etc. Includes hysteresis loops, magnetization curves, and physical properties.—Allegheny Ludlum Steel Corp., 2020 Oliver Bldg., Pittsburgh 22, Pa.
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Stainless Steel. New 45-page loose-leaf bound brochure lists types, performance and application data for stainless steel and other metals with controlled porosity. Includes data on various porous stainless-steel filter elements and containers.—Micro Metallic Corp., 30 Sea Cliff Ave., Glen Cove, N. Y.
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Aluminum Coating. New 4-page Bulletin 1252 describes maker's "Alodine 1000" aluminum protective agent which can be applied to fans, ducts, etc.—American Chemical Paint Co., Ambler, Pa.
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Beryllium-Copper Casting Handbook. New 48-page "Tru-Cast Handbook" describes methods of utilizing beryllium-copper cavities and cores in molding and other applications. Includes charts and diagrams explaining properties of beryllium copper.—Manco Products, Inc., P. O. Box 5231, Detroit 35, Mich.
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Molded, Extruded Rubber. New 16-page Buying Guide 786 gives definitions, performance characteristics, and tables of properties available in many types of common rubber and plastic compounds.—General Tire & Rubber Co., Industrial Products Div., Wabash, Indiana.
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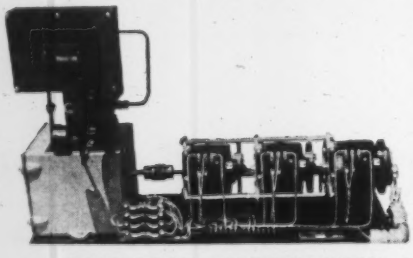

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MECHANICAL COMPONENTS

Precision Gears. New 64-page Catalog D-64 lists maker's line of precision stock gears, including helical, worm, bevel, standard hub type, and hubless. —Dynamic Gear Co., Inc., 20 Merrick Rd., Amityville, L. I., N. Y.

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Instrument Components. New 64-page Catalog 5 lists maker's large line of precision shafts, spacers, bronze bearings, sleeve coupling, dowel pins, spur gears, hubs, worm gears, adapters, retainer rings, lead screw assembly, etc.—PIC Design Corp., 160 Atlantic Ave., Lynbrook, L. I., N. Y.

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Bellows, Metal Hose. New 16-page Catalog 145 describes and illustrates maker's "Flexon" bellows and features complete information on convoluted and corrugated types of flexible metal hose.—Flexonics Corp., 1409 S. Third Ave., Maywood, Ill.

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Screw-Lock Insert. New 4-page Brochure 715 A contains selection tables, line drawings showing proper installation in blind and through holes and instructions on use of maker's new screw-lock insert.—Heli-Coil Corp., Danbury, Conn.

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Vibration Isolators. New 4-page "Barry's Product Digest" describes and illustrates maker's line of vibration isolators and shock mounts.—Barry Corp., 1000 Pleasant St., Watertown, Mass.

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